

# Smart Cities

Omar Selim









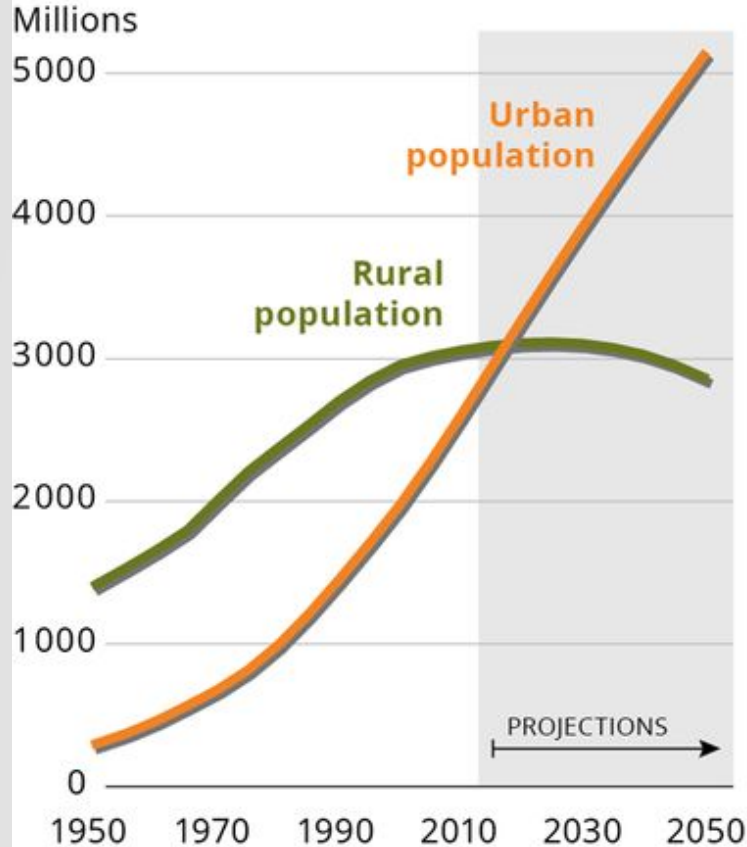
**68%** of the world population projected to live in urban areas by 2050, says UN.





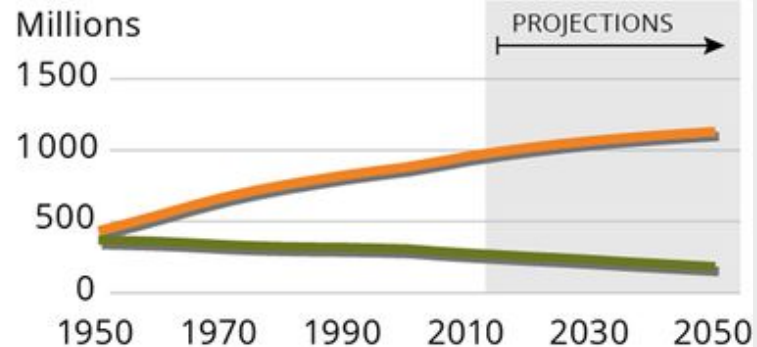
## Less developed regions

Africa, Asia (excluding Japan), Latin America and the Caribbean, Melanesia, Micronesia and Polynesia.



## More developed regions

Europe, Northern America, Australia, New Zealand and Japan.





# Why cities need to become **smart now**

In **1960**, the **global population** around **3** billion

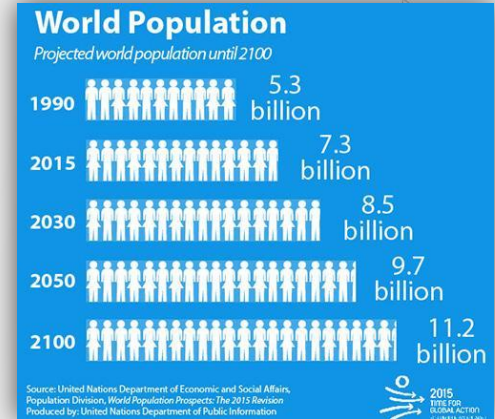
The World Bank puts the **2016** population at **7.44** billion – a rise of almost **146%** in just **56** years

According to the Swiss-based international standards agency, International Electrotechnical Commission (IEC),

*“**every day**, urban areas grow by almost **150,000** people, either due to **migration** or **births**”.*

A dramatic **rise in demand** on resources, from food and water through to energy, space, and clean air.

cities that were designed for yesterday's populations, using yesterday's technologies are **beginning to buckle** under the strain of **meeting the needs** of today's never-envisioned populations.





# Why cities need to become **smart now**

33 megacities with more than ten million inhabitants )

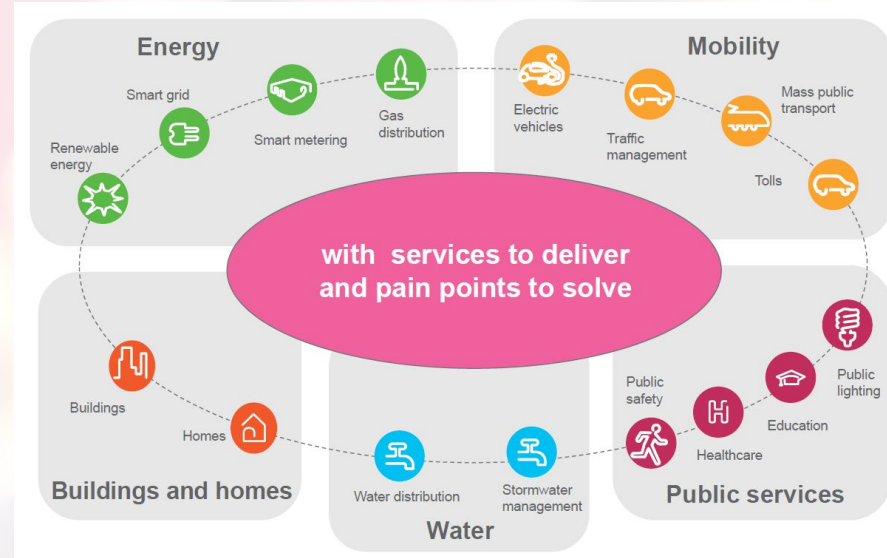
The challenge will be to supply these populations with basic resources like safe **food**, clean **water** and sufficient energy, while also ensuring overall **economic**, **social** and **environmental** sustainability.

According to the World Health Organization's Global Health Observatory (WHO GHO), **ambient air pollution** contributes to **5.4% of all deaths**.

Currently, **92% of the world's population** lives in **places where air quality exceeds WHO guideline limits**.

promises modern cities must fulfil if they are to stay competitive and provide a decent **quality of life to their citizens**:-

Sufficient fresh **water**;  
universal access to **cleaner energy**;  
the ability to **travel efficiently** from one point to another;  
a sense of **safety and security**:





## A hand holding a smartphone, with a miniature city skyline (resembling New York City) appearing to sit on top of the screen, symbolizing mobile technology and urban connectivity.

while at the same time **improving the quality of life** for inhabitants through benefits such as :

- Better Planning & Economic Growth
- Less Pollution and Reduced Energy Consumption
- Better and Faster Infrastructure
- Less Commuting & Better Transportation Systems
- Reduced Traffic Accidents
- Better Crime Control
- Responsive Government Action
- Cost-Efficiencies & Competitiveness



Definitions and overviews, Smart Cities Council, accessed April 2018



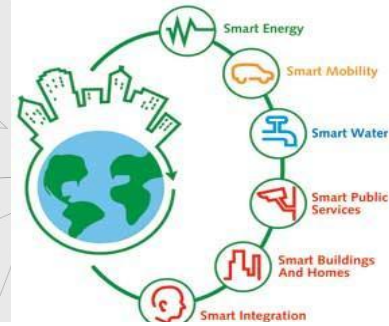
as one that has **digital technology** embedded across **all city functions**.

a “process, or series of steps, by which cities become more ‘livable’ and resilient and, hence, able to **respond quicker** to new challenges.” according to a UK government smart

according to a UK government smart cities report

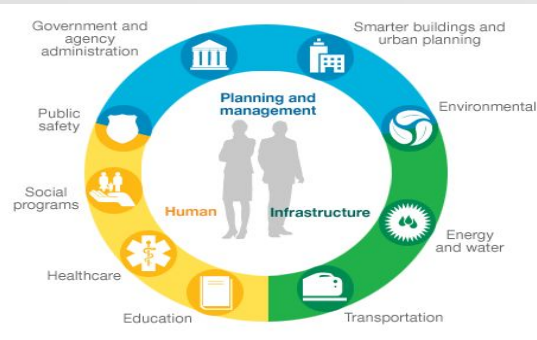
# Smart Cities Definition.

. In year 2007, Prof Rudolf Giffinger of Vienna University of Technology formally coined the term “Smart City” Smart City uses technology and ICT to better quality & performance to engage more effectively and actively with its citizens. The Smart City includes government services, transport, traffic management, energy, health care, water and waste.



## The Definitions of Smart Cities

Division	Definition
<b>Ministry of Land, Infrastructure and Transport</b>	Future city that utilizes cutting-edge ICT for all urban resources such as human resources, environment, energy, transportation, and urban infrastructure to realize continuous economic development and quality of life
<b>ITU</b>	Smart Sustainable City is <b>an innovative city that uses ICT to improve the quality of life, the effectiveness of city operations and services</b> , and competitiveness. This ensures the needs of present and future generations in economic, social, environmental and cultural aspects.
<b>IBM</b>	A city that can collect, analyze, and integrate information using ICT, which is the key to the core system to operate the city.
<b>Hall(2000)</b>	A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens
<b>Smart Cities Council</b>	City using IT and ICT to improve livability, workability and sustainability





# smart city services



	Traditional city	Smart city
Infra-structure	2-dimensional city	3-dimensional city
	Segmented	Organic
Operation	Mechanical	Creative
	Controlled	Self-organized
Services	City-centered	Citizen-centered
	Process-based	Data-based



Traditional City

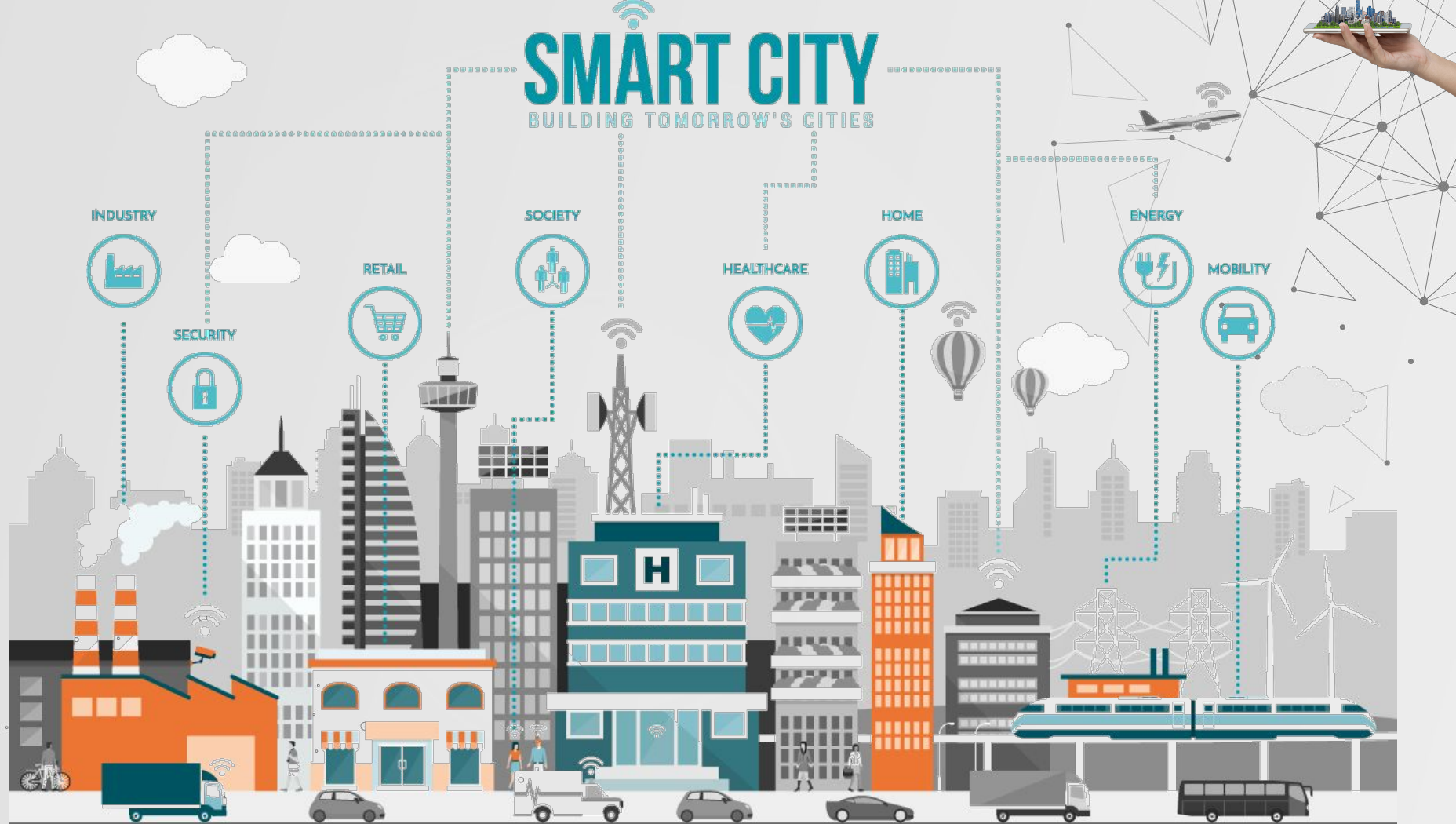


## Smart City Services

	Services
Transport /Logistics	<ul style="list-style-type: none"> <li>Intelligent Safety Management System for subway/rail/bus</li> <li>Smart Crosswalk</li> <li>Autonomous Car / Smart Parking</li> <li>Traffic Information Collection and Bypass Road Guidance</li> <li>Traffic/Cargo Traceability</li> </ul>
Environment	<ul style="list-style-type: none"> <li>Air Quality Management System</li> <li>Subway Vent Management System</li> <li>Smart City-Environment Management System</li> </ul>
Energy	<ul style="list-style-type: none"> <li>Smart Building Energy Save System</li> <li>Electric Car Charging Station</li> <li>Smart Store Energy Management</li> </ul>
Safety	<ul style="list-style-type: none"> <li>Smartcity Disaster Prevention System</li> <li>Safe Driving Alert System</li> <li>Smart anti-kids-lost services</li> <li>Smart Traffic Safety Services in School Zones</li> <li>Socially Underprivileged Security Services</li> </ul>
Healthcare	<ul style="list-style-type: none"> <li>Medicines and Medical Devices Management System</li> </ul>
Food Services	<ul style="list-style-type: none"> <li>Food Safety Systems</li> <li>Disclosure / Tracking / Recall Service</li> </ul>

# SMART CITY

BUILDING TOMORROW'S CITIES





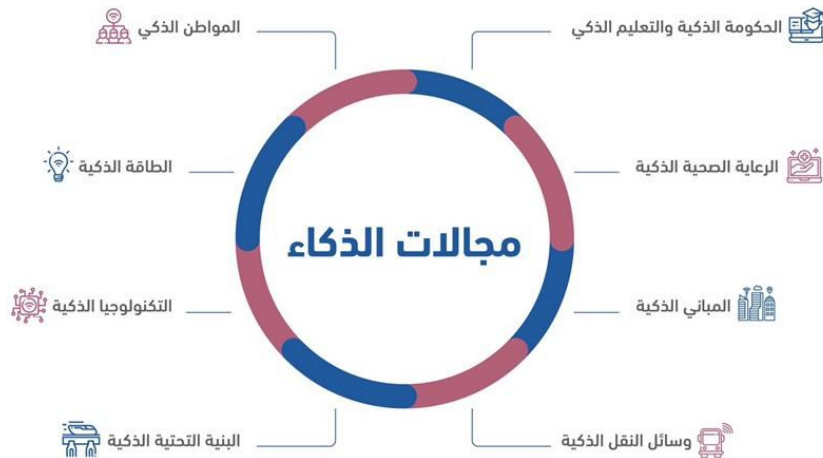


## مكونات المدينة الذكية

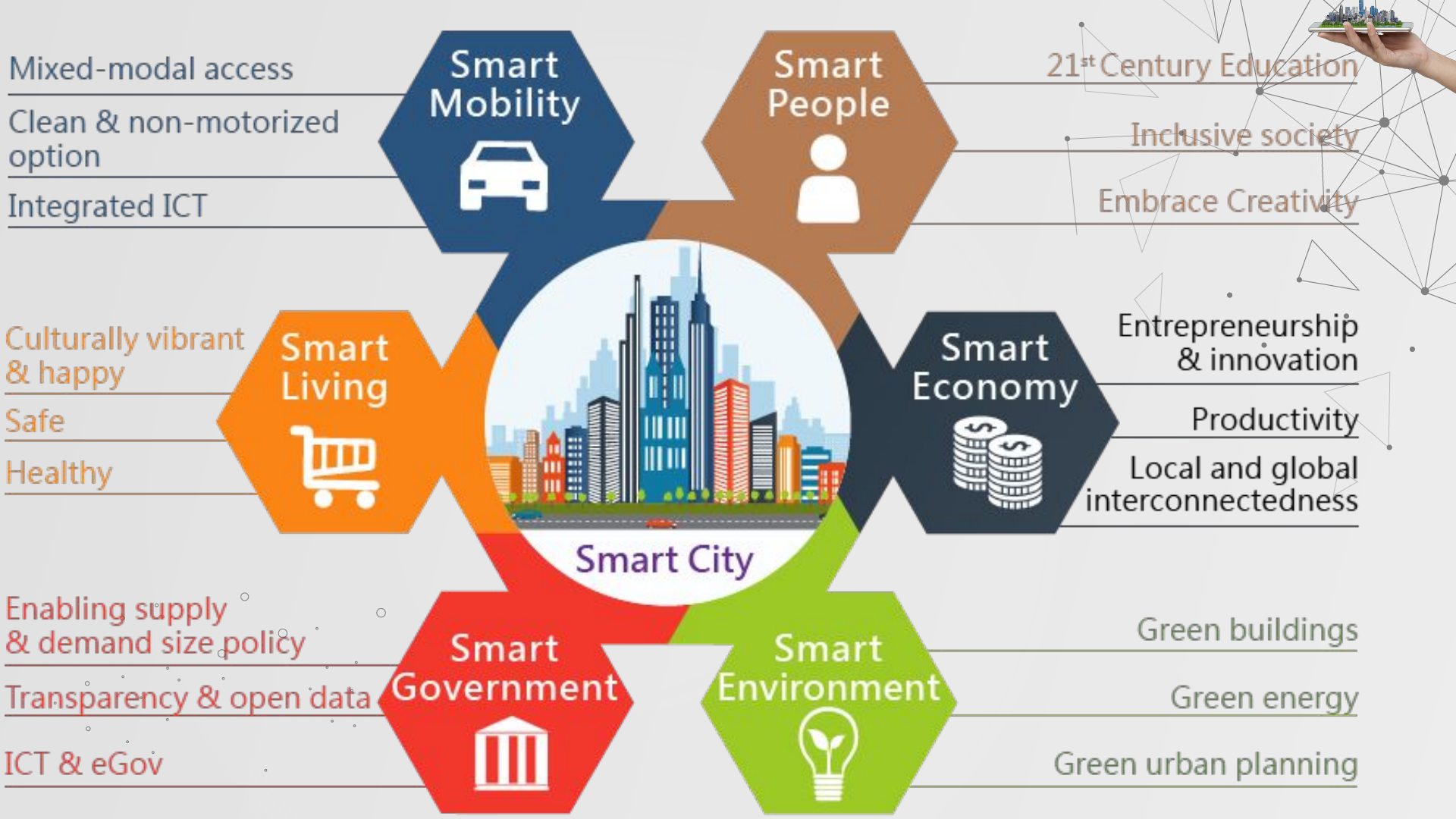


## مستقبل المدن الذكية

وفقاً لـ Forst & Sullivan فإن أكثر من 40% مدينة عالمياً ستصبح مدن ذكية في عام 2020 وأكثر من 50% من المدن الذكية لعام 2025 ستكون من أوروبا وأمريكا الشمالية والصين والهند



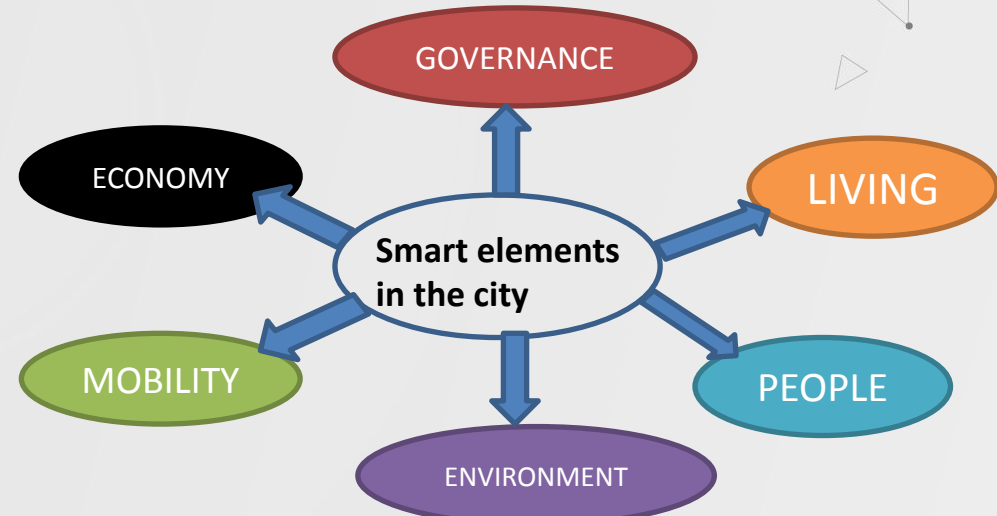




# SEVEN SMART CITY PILLARS

Bhubaneswar has identified seven smart city pillars which align the citizen's aspirations and needs with city systems.

- 1.
2. City planning and design
3. Urban utilities (water, smart waste management, sanitation and waste water management, energy, and ICT / IT connectivity)
4. Shelter, with a focus on inclusive housing
5. Economic development, economy and employment
6. Social development, including identity and culture, education, health, open spaces, safety and security, and air quality





# Mobility

Urban mobility, including street design  
and public transport

## Vehicles

- intermodality
- vehicle sharing / pooling
- low environmental impact
- non-motorized transport



## Infrastructure

- road networks and intelligent traffic lights
- monitoring and controlling
- for electric vehicle
- Infrastructure
- communication V2V, V2I

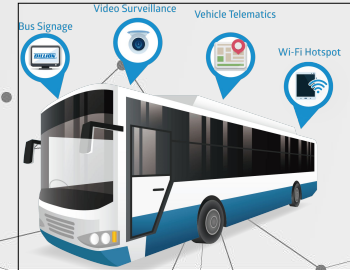


## People

- sharing information
- emergency management
- security

## Service

- fleet management
- freight logistics
- electronic payment systems



# Inclusion



## Education / Training

- evolution of educational paradigms
- learning tools for disabled
- inclusion for foreign students
- training for immigrants
- professional training for unemployed

## Social Communication

- neighborhood level and social support
- volunteering support
- Integration / involvement of unemployed
- contrast to the immigrants isolation



## Government

- e-administration
- e-democracy
- e-participation
- Governance, including citizen participation and intelligent government services

## Assistance

- Moving autonomy for disabled
- monitoring the elderly &
- promoting healthy lifestyles
- security and emergency management for frail people



# Life & Health

## Environment and Territory

- waste / water management
- environmental quality analysis
- Territory monitoring
- territorial planning
- disaster prevention
- Infrastructure monitoring



## Culture and Tourism

- promotion of cultural heritage
- conservation and upgrading of assets
- promotion of tourism

## Security

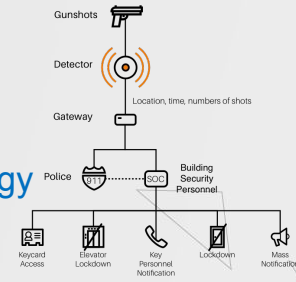
- night urban surveillance/prevention and fighting crime

- monitoring and managing of Big events

- public order management

- security for moving users

### Gunshot Detection Technology



## Accessibilità

- to the structures / usability
- to the cultural resources of the city



# Energy

## Buildings

- Consumption monitoring
- Plant automation / energy saving systems
- Interfacing with energy networks
- Interfacing with Renewable Energy Sources



## Infrastructures

- smart grid
- smart heating/cooling networks
- Support for vehicular networks (electric recharge)

## People

- interactions between man and building
- saving energy awareness policies
- community management (e.g. at condominium level)

## Vehicles

- low impact vehicle
- driving style (eco-driving)
- travel planning (eco-routing)





# How to implement and support the strategy



- **SMILE** cannot be separated by considerations of **economic sustainability**, in order to:
  - better address the resources and avoid investments incorrect or counterproductive
  - Reduce the risk of sanctions
  - Better focus the main objectives, taking into account options for long-term sustainability



- ☐ Public-private partnership, pre-commercial procurement of innovation
- ☐ National R&D Projects and EU (Horizon 2020)
- ☐ Rules and regulations to support the dissemination of developed solution





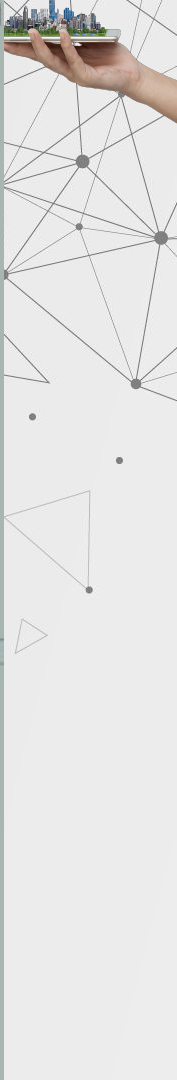
<https://apps.london.gov.uk/greener-city/#14.88/51.45081/-0.01014/0/45> london







Gatis  
Sluka  
2019







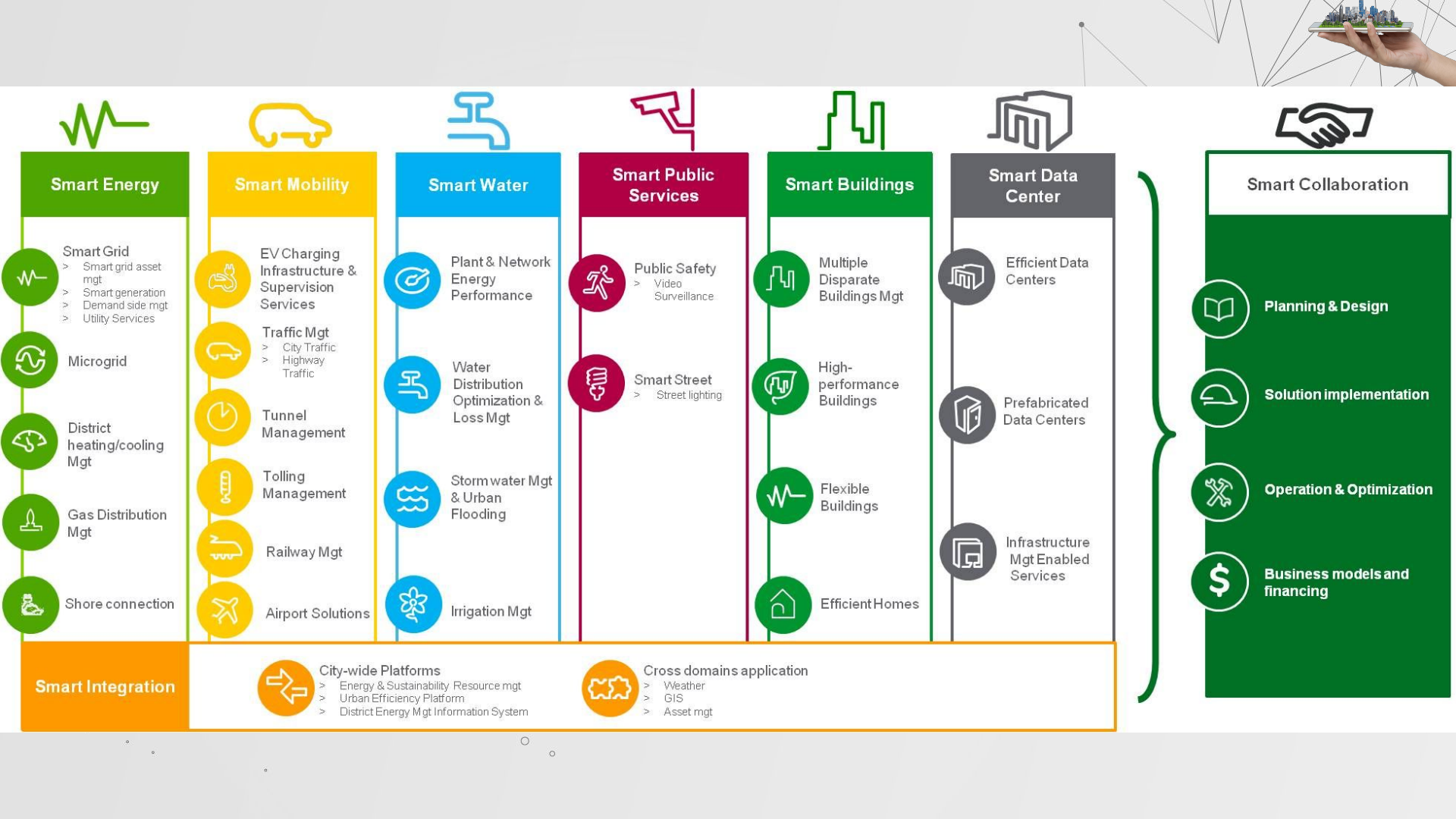


How will we better plan, design, construct  
and operate our cities and infrastructure in  
a more sustainable way for the future?

We must Change our Ways







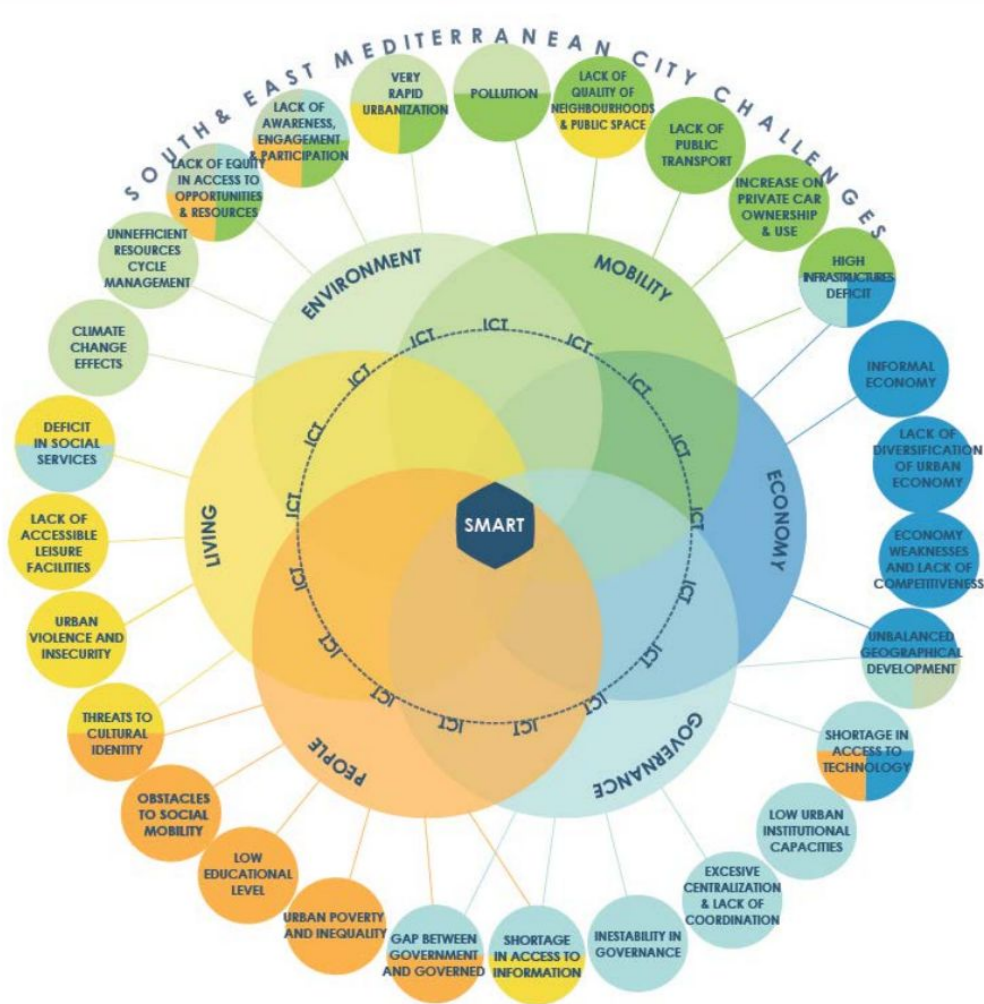


Figure 2. South & East Mediterranean City challenges correlated with Smart City dimensions



# SMART CITY



Ubermetrics



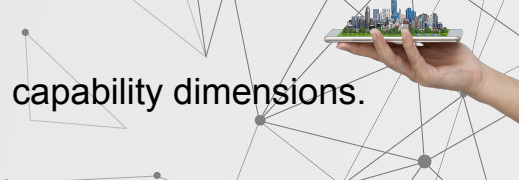
## ... fueled by a combination of disruptive technologies and social innovations ...

Most new technologies and social innovations are disruptive on their own. The combination of them is even more powerful and creates a 'perfect storm' of disruption.



# Smart City Capability Framework

Successfully building a smart city requires a clear strategy and maturity in seven capability dimensions.



## Goals



Economic growth



Quality of life, a good city to live in



Ecological footprint, sustainability

## Challenges



Social cohesion, inclusiveness



Secure digital environment, privacy



Resilience



Smart Mobility



Smart Safety



Smart Energy, Water & Waste



Smart Buildings & Living



Smart Health



Smart Education



Smart Finance



Smart Tourism & Leisure



Smart Retail & Logistics



Smart Manufacturing



Smart Government



## SMART CITY USE CASES



SMART  
PARKING



WEATHER  
SENSORS



DIGITAL  
SIGNAGE



ACOUSTIC  
SENSORS



WATER & GAS  
METERING



TRAFFIC  
LIGHTS &  
CONTROLS



ELECTRIC  
VEHICLE  
CHARGING



SOLAR  
INVERTERS



SECURITY AND  
SURVEILLANCE



WASTE  
MANAGEMENT



# Smart Solutions

## E-Governance and Citizen Services

- 1 Public Information, Grievance Redressal
- 2 Electronic Service Delivery
- 3 Citizen Engagement
- 4 Citizens - City's Eyes and Ears
- 5 Video Crime Monitoring



## Waste Management

- 6 Waste to Energy & fuel
- 7 Waste to Compost
- 8 Waste Water to be Treated
- 9 Recycling and Reduction of C&D Waste



## Water Management

- 10 Smart Meters & Management
- 11 Leakage Identification, Preventive Maint.
- 12 Water Quality Monitoring



## Energy Management

- 13 Smart Meters & Management
- 14 Renewable Sources of Energy
- 15 Energy Efficient & Green Buildings



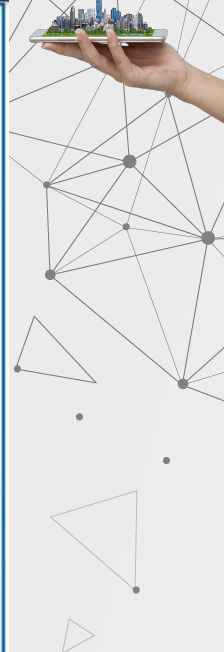
## Urban Mobility

- 16 Smart Parking
- 17 Intelligent Traffic Management
- 18 Integrated Multi-Modal Transport



## Others

- 19 Tele-Medicine & Tele Education
- 20 Incubation/Trade Facilitation Centers
- 21 Skill Development Centers



# Changing our Ways

## Old Way

Analog  
Silos  
Reactive  
Error Prone  
Disconnected  
2D Paper Drawings

## New Way

Digital  
Collaborative  
Proactive  
Predictable  
Interoperable  
Intelligent 3D Models

**We must build and share Smarter Models in a smarter way**



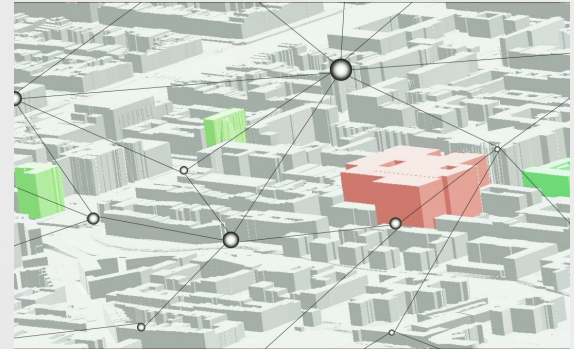
GeoBIM = integration of geoinformation with BIMs

3D geoinformation:

3D city models

+ Building Information Models

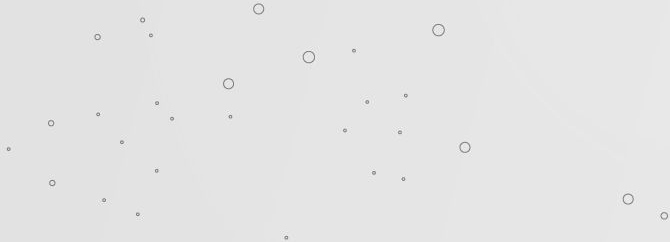
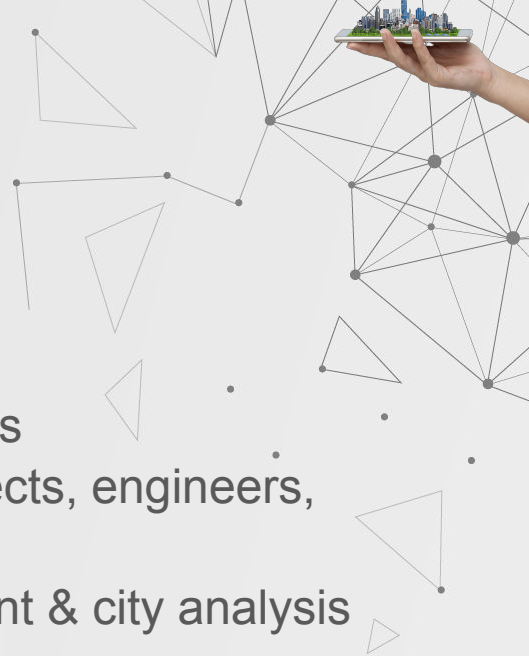
1. Integration of data (common characteristics, they fit together)
2. Data interoperability
3. Reliable conversions BIM « GIS
4. Integration of procedures (BIM and GIS (Geographic Information System) tools)





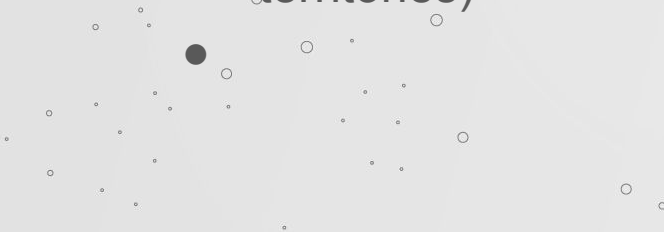
# GEO world point of view

- High level of detail 3D cadaster
- No tasks duplication (3D data collection)
- Efficient databases updates without additional costs
- Effective data exchange with professionals (architects, engineers, environmental scientists, etc.)
- Stronger information for lifecycle asset management & city analysis



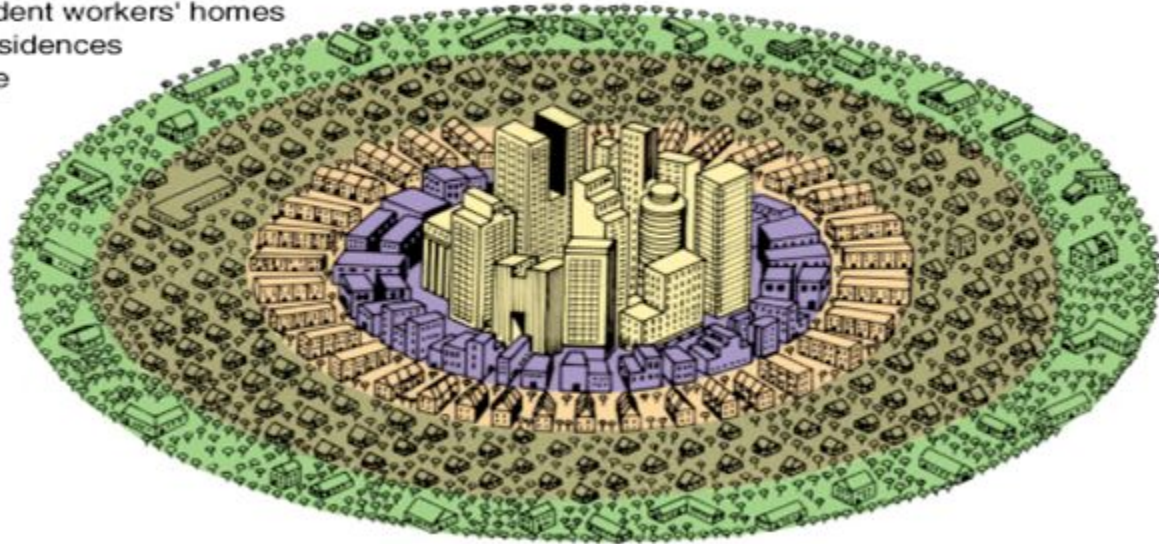
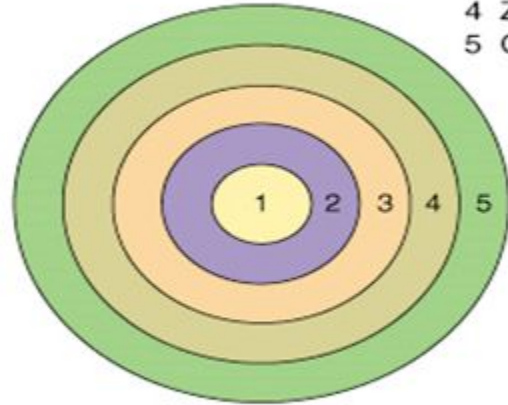
# BIM world point of view

- Context for design reference
- Improved test of building properties: designed building into its context
- Test of the impact of the building on the city or landscape.
- Multiscale vision (from construction elements to whole territories)



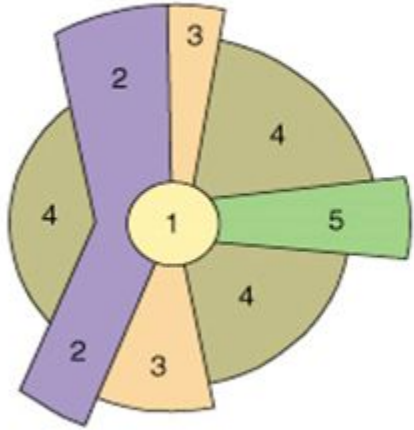
# Modeling Cities:concentric zone model

- 1 Central business district
- 2 Zone of transition
- 3 Zone of independent workers' homes
- 4 Zone of better residences
- 5 Commuter's zone

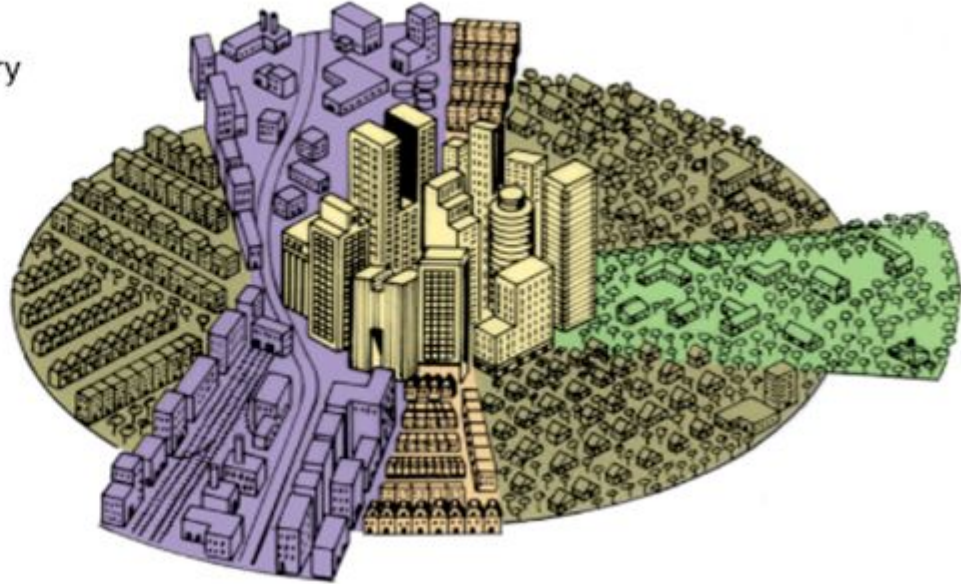




# Modeling Cities: sector model



1. Central business district
2. Transportation and industry
3. Low-class residential
4. Middle-class residential
5. High-class residential



- Stresses the importance of transportation corridors. Sees growth of various urban activities as expanding along roads, rivers, or train routes.



**Intelligent  
Asset  
Management**

**Smart Grids  
&  
Energy  
Management**

**EVs  
&  
Connected  
Vehicles**

**Water  
Metering &  
Management**

**Smart Living  
&  
Building  
Automation**

**Connected  
Healthcare &  
Wellness**

**Public Safety  
&  
Security**

“You want to be able to monitor, measure, and control your services & assets to gain better outcomes for people”



**Air Quality  
Sensor**



**Noise Monitor**

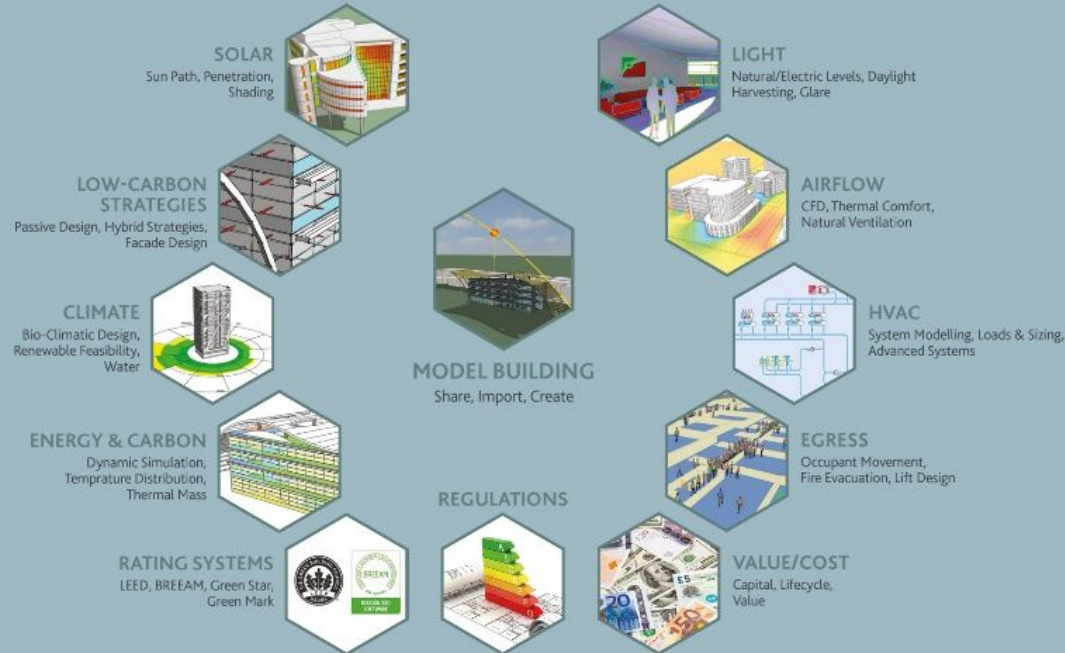


**NYC  
Smart Bikes**



**Flood Sensors  
Oxford**

# VIRTUAL ENVIRONMENT



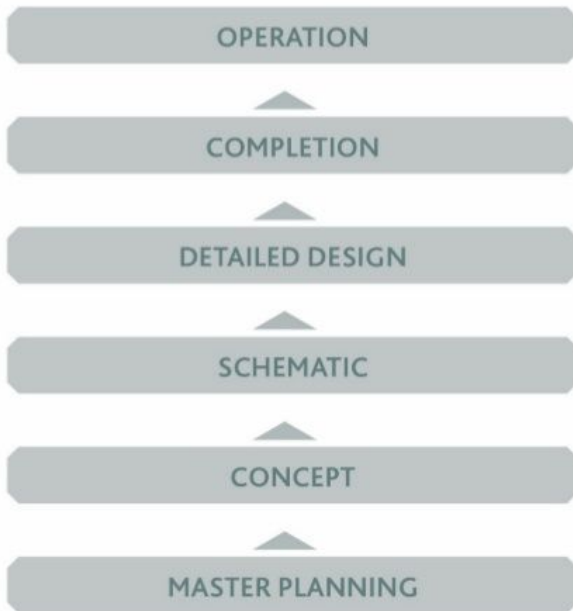


# Who is the typical building simulation client?



## EARLY STAGE – DETAILED DESIGN

Use VE for Engineers across the entire design lifecycle



## ARCHITECTURAL

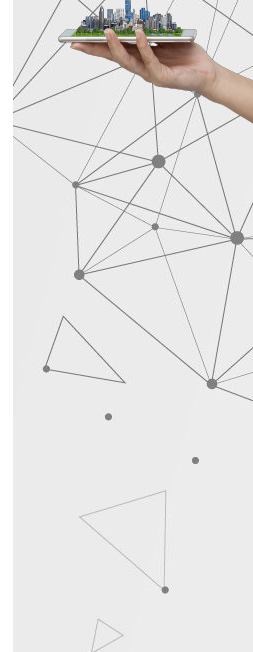
- Designers
- Architects
- Master planners
- Urban designers
- Interior Designers

## ENGINEERS

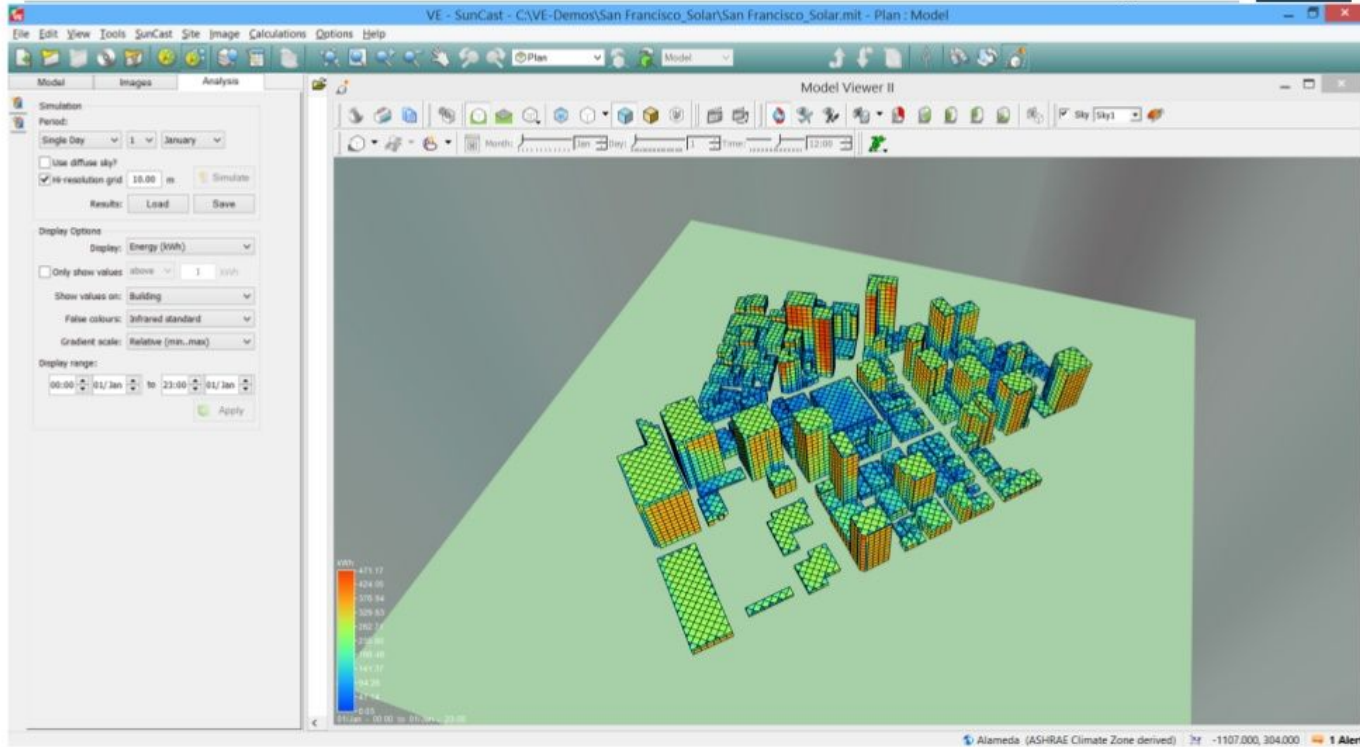
- HVAC
- Mechanical
- Electrical
- Building Physics
- Other “green” rating systems

## GREEN CONSULTANTS

- BREEAM
- LEED
- DGNB
- Estidama
- Other “green” rating systems



# Surface Solar Radiation: Winter Day

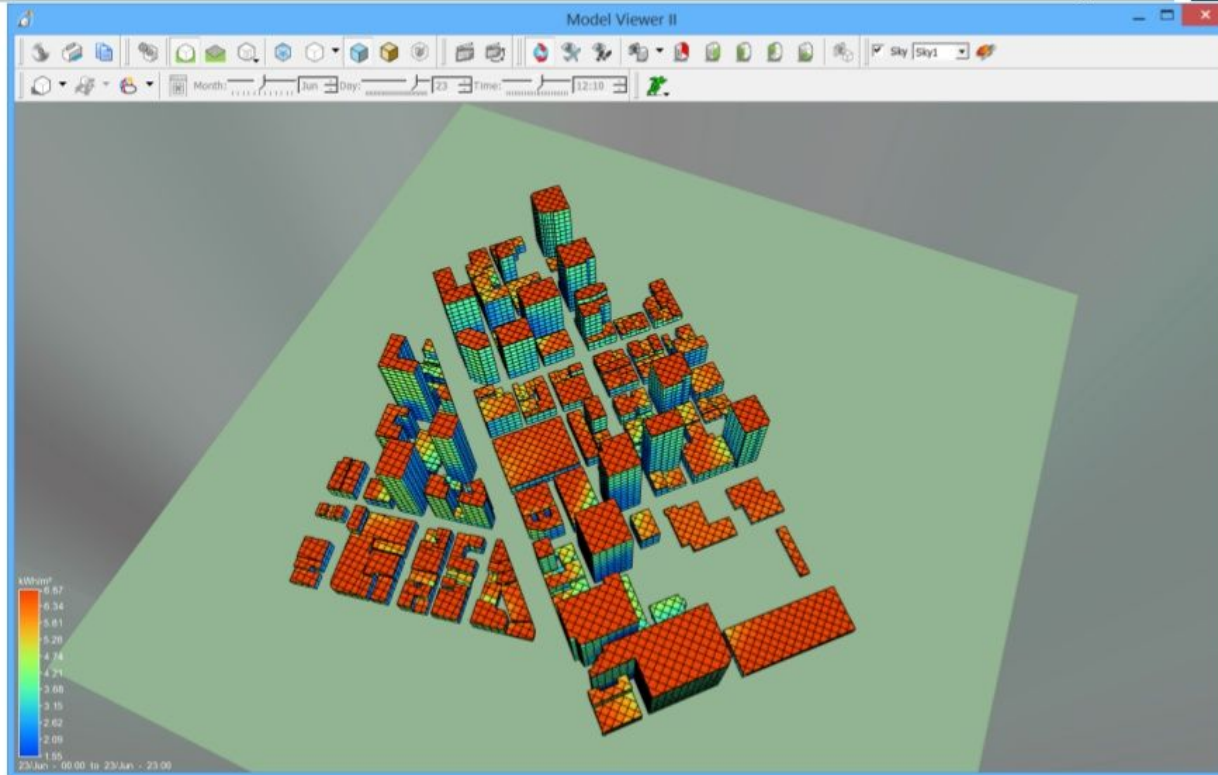


Surface Solar Radiation: 15 January (Red High, Blue Low)

[www.iesve.com](http://www.iesve.com) UNITED KINGDOM | IRELAND | UNITED STATES OF AMERICA | CANADA | INDIA | AUSTRALIA



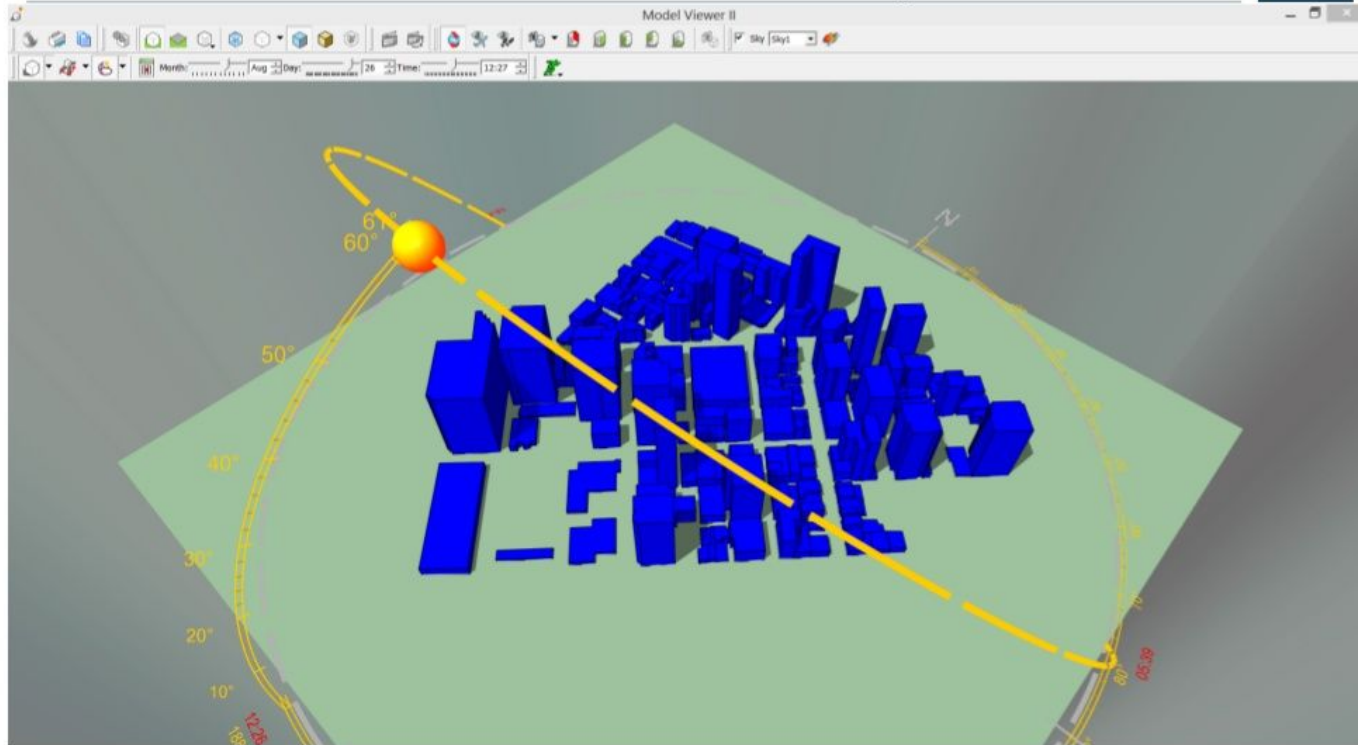
# Surface Solar Radiation: Summer Day



Surface Solar Radiation: 23 June (Red High, Blue Low)



# Solar Shadow Study

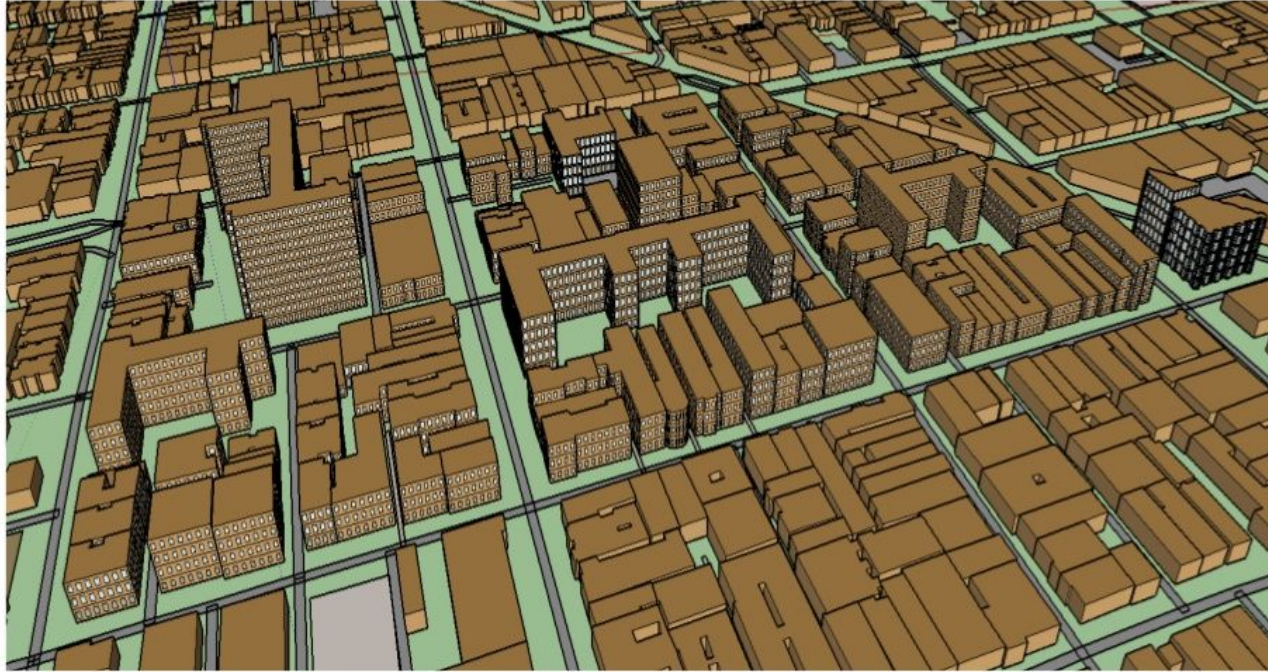


Shadow studies

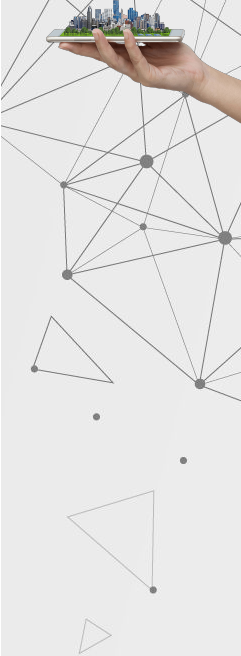
[www.iesve.com](http://www.iesve.com) UNITED KINGDOM | IRELAND | UNITED STATES OF AMERICA | CANADA | INDIA | AUSTRALIA



# Energy Analysis



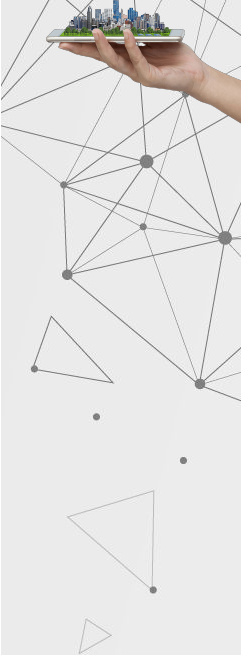
District buildings modelled in more detail



# Energy Analysis

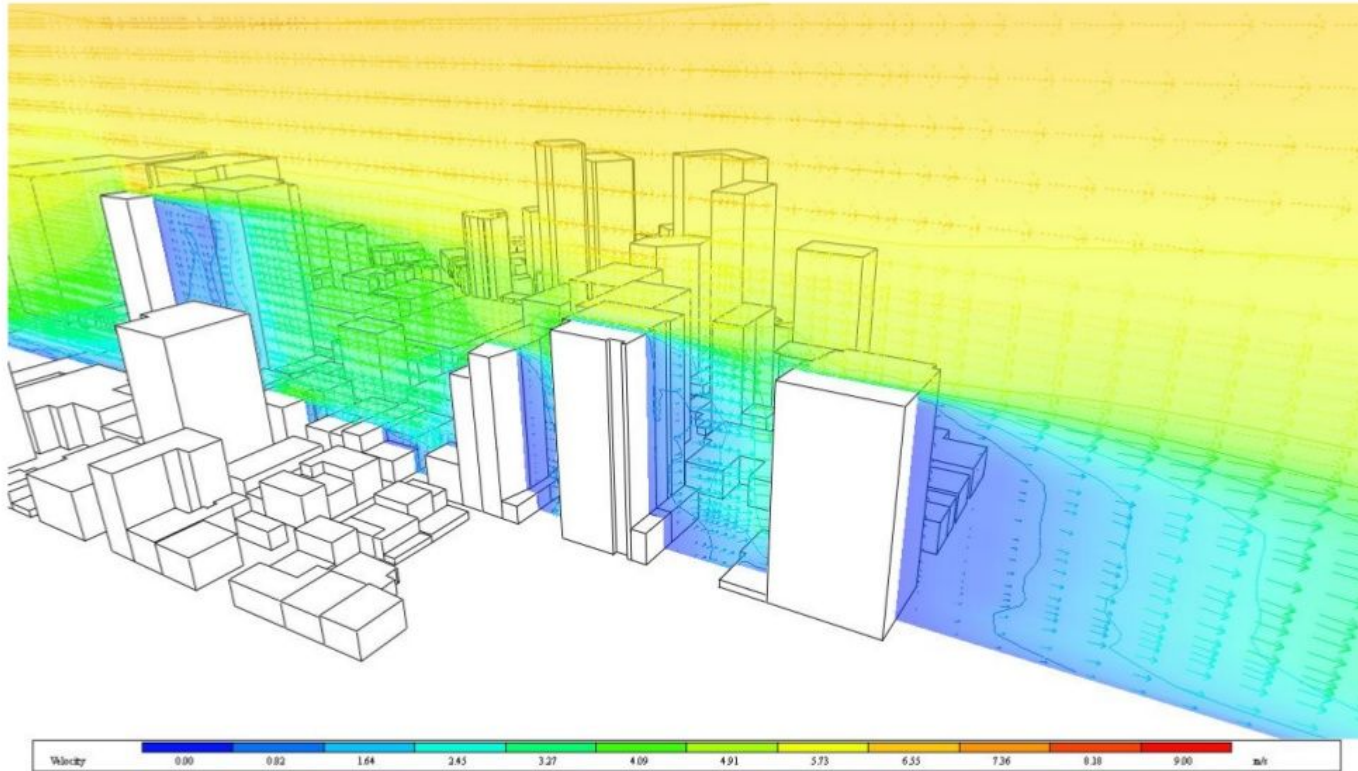


Define buildings by spaces types for general analysis



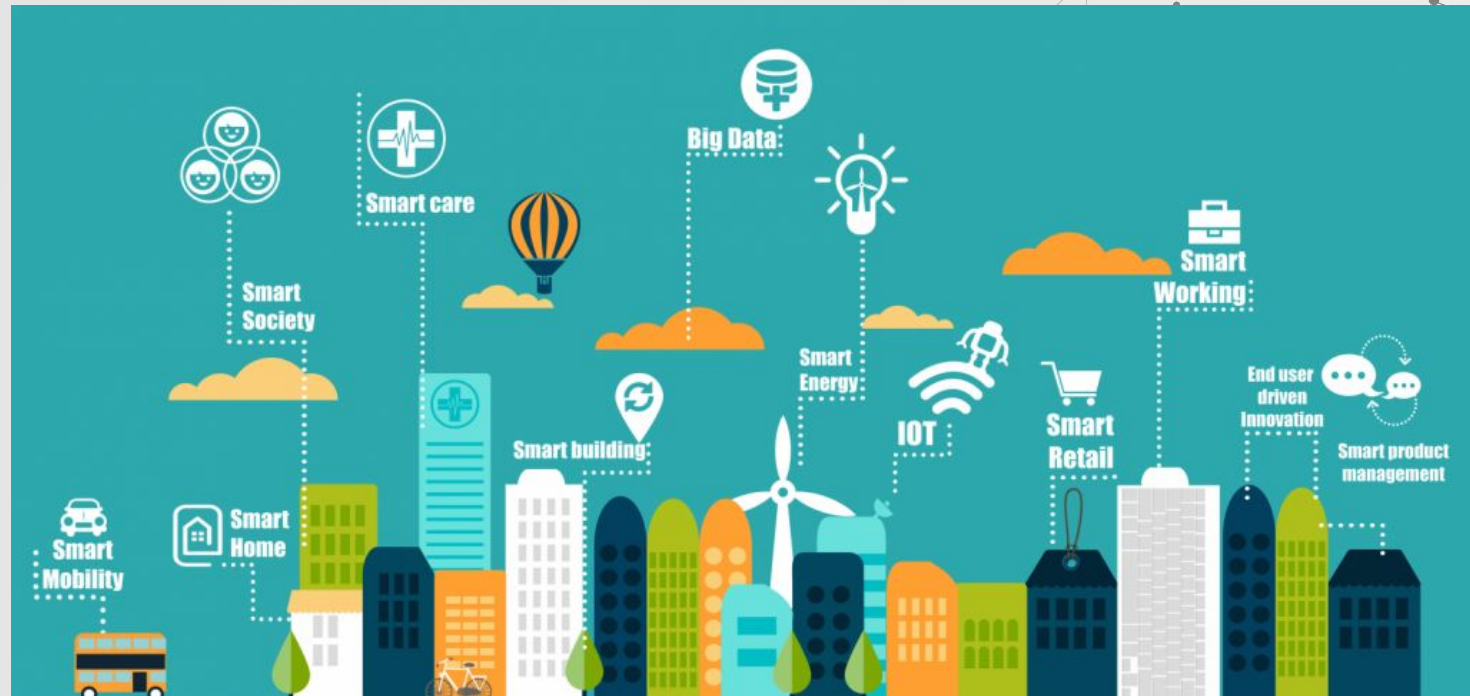


# VE-Pro: External Air Flow



# Digital Cities

Combine mapping, building, civil engineering, utility and other 3D data into accurate models that can be visualized, analyzed and shared





(1) 3D Data Capture /  
Data Collection



(2) 3D Data Standards  
and Modelling



(3) 3D Data Sharing



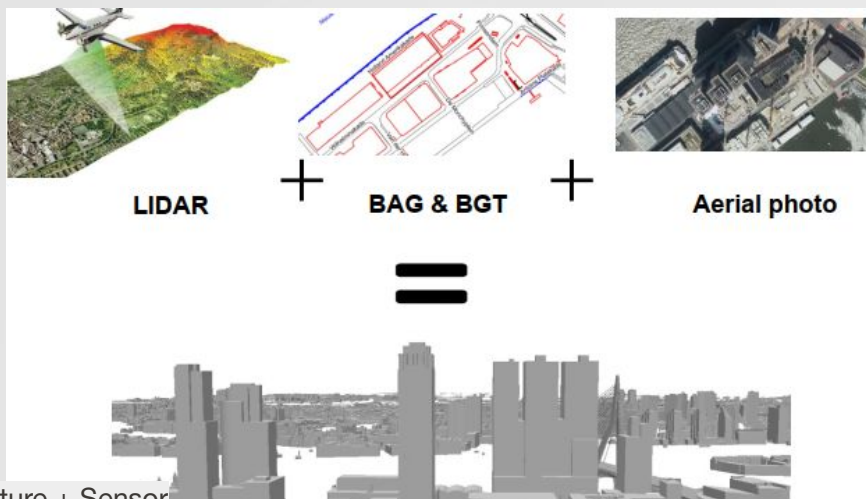
Project Areas



Mesh Models



3D Textured Mesh Model



Data Explosion Location + Feature + Sensor  
Point Cloud + Realistic Mesh + Semantic  
Model + Volumetric Data + Live Data +  
Visualization + Simulation + IoT + Analytics +  
...



# Process for Building Infraworks Model

## PHASE I

IMPORT EXISTING GIS DATA  
FOR PROJECT AREA

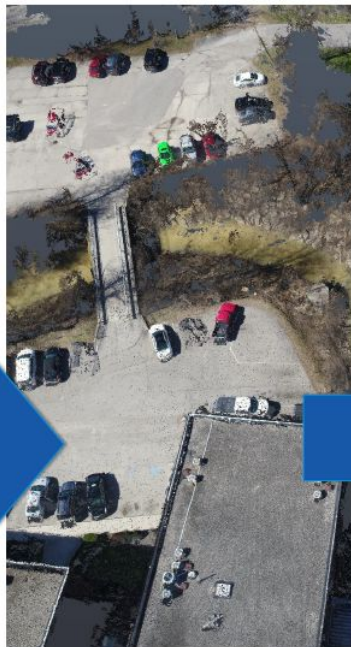
Topography, Roads, Parking  
Lots, Streams, Buildings, Etc



## PHASE II

IMPORT REALITY CAPTURE  
POINT CLOUDS

UAV Data  
Laser Scan Data



## PHASE III

ADJUST ELEMENTS TO  
MATCH & ADD DETAIL

Road & trail alignment, building  
façade detail, etc.



## PHASE IV

ADD TRAIL FEATURES TO  
MODEL

Bike path, light poles, cars,  
people, vegetation, Etc



can be  
All rights  
preserved

These new smart cities are likely to **be powered**, by **seven technologies** that **The World Bank believes** will disrupt and transform **how cities deliver services to their citizens**



5G mobile networks,

Blockchain

Artificial intelligence

Autonomous vehicles

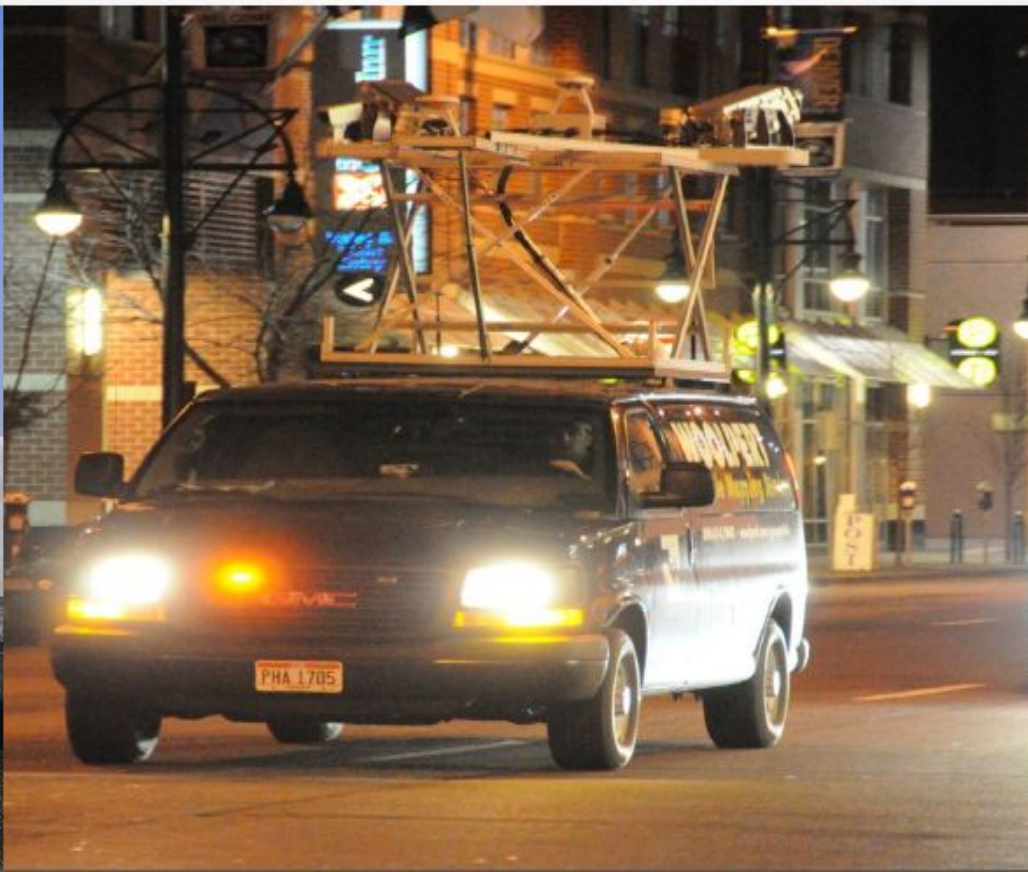
Low-cost space exploration  
and micro-satellites

Biometrics

Drones

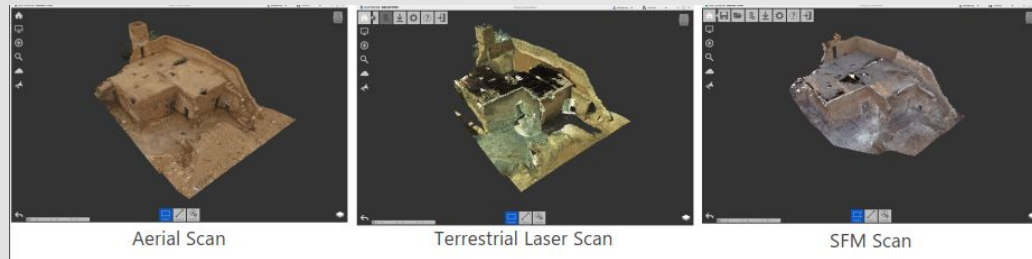
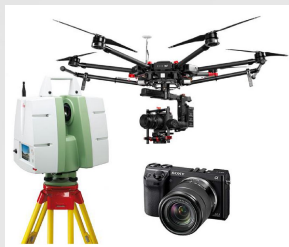
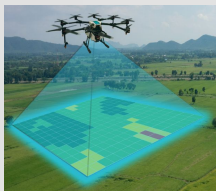


# 3D Survey Integrated Mapping using LiDAR-Static/Mobile/Aerial Scanning with Supplemental RTK GPS/Digital Leveling/TS/UAV Existing Conditions





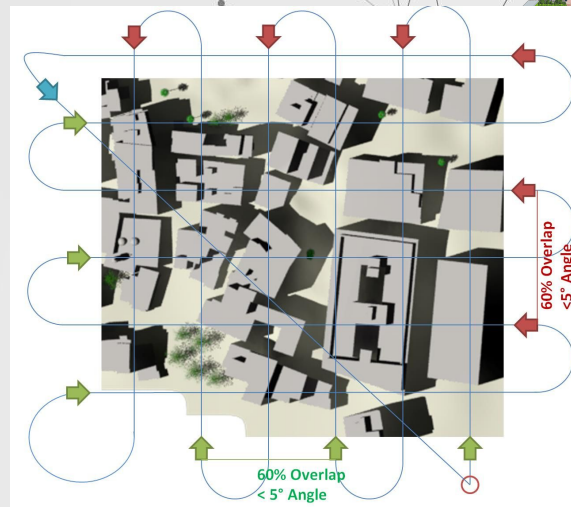
# Create 3D Digital Cities Using Drones



Aerial Scan

Terrestrial Laser Scan

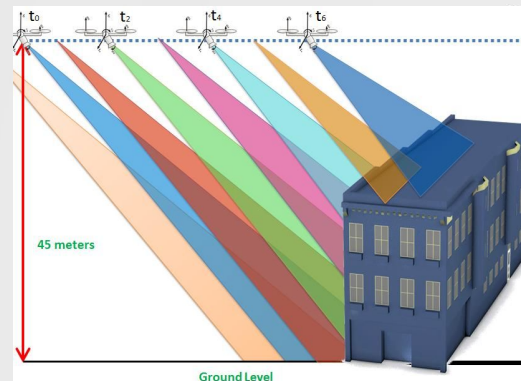
SFM Scan



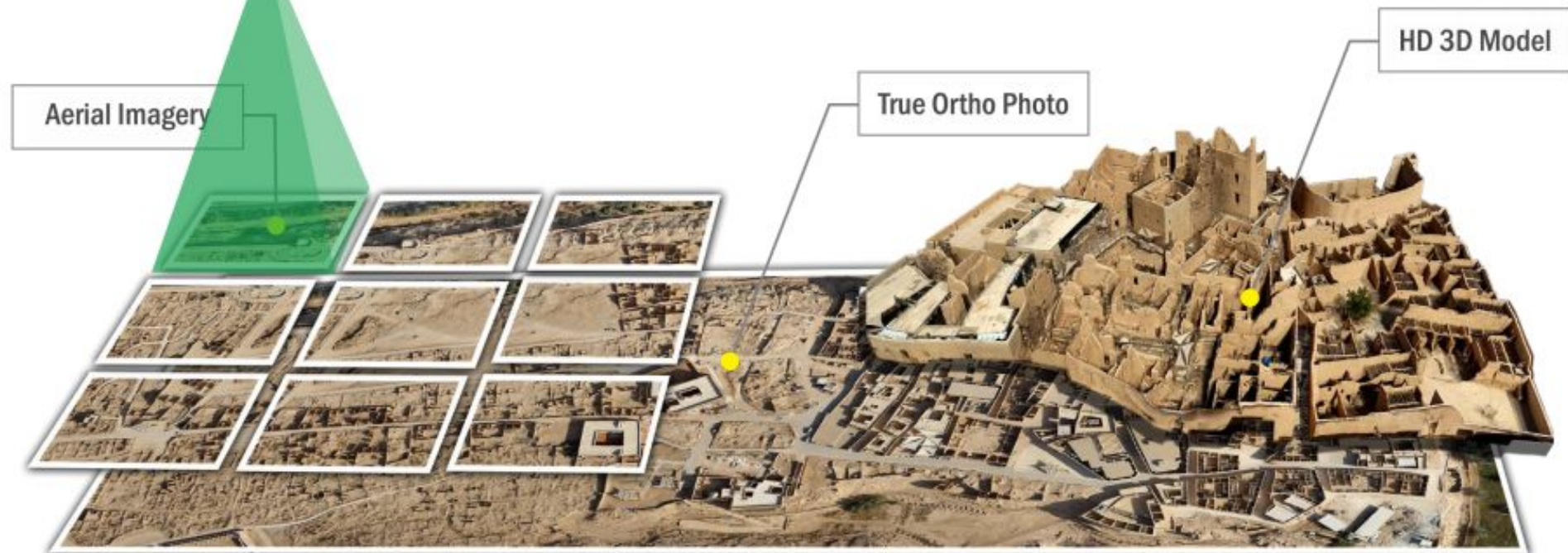
Satellite image +/- 30 cm



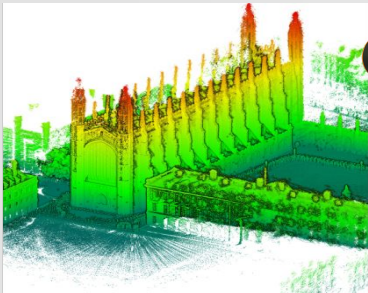
FalconViz drone image +/- 2 cm



# 3D Digital City – Drone Based



# drone and vehicle based scanning and camera device



zeb horizon (detail context capture scan)



Reality modeling is the process of capturing the physical reality of an infrastructure asset, creating a representation of it, and maintaining it through continuous surveys. Bentley's reality modeling software, ContextCapture, provides you with real-world digital context in the form of a 3D reality mesh.

## COLLAGE

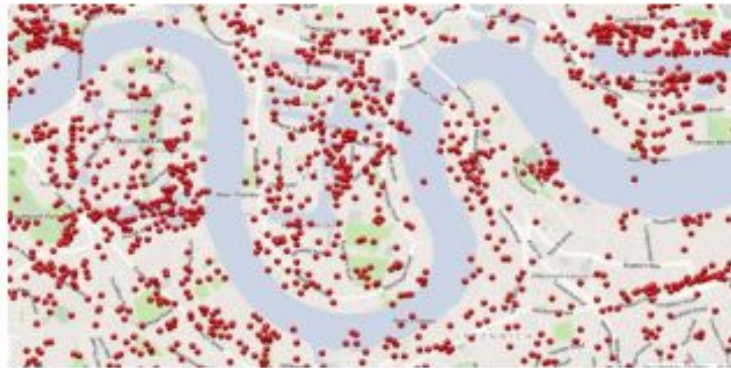
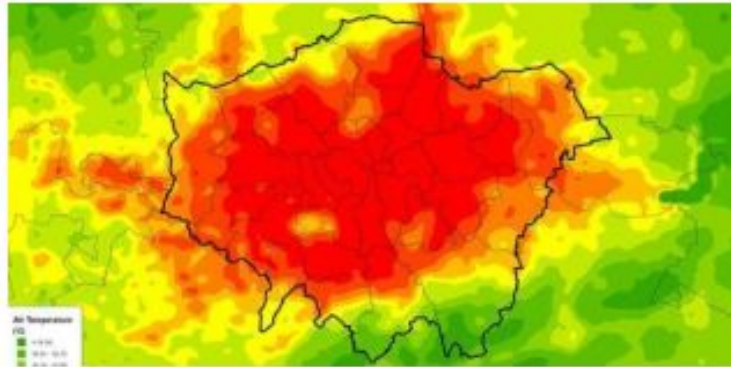
Post-processing software for Topcon's mass data solutions

Processes the raw data for the following systems:

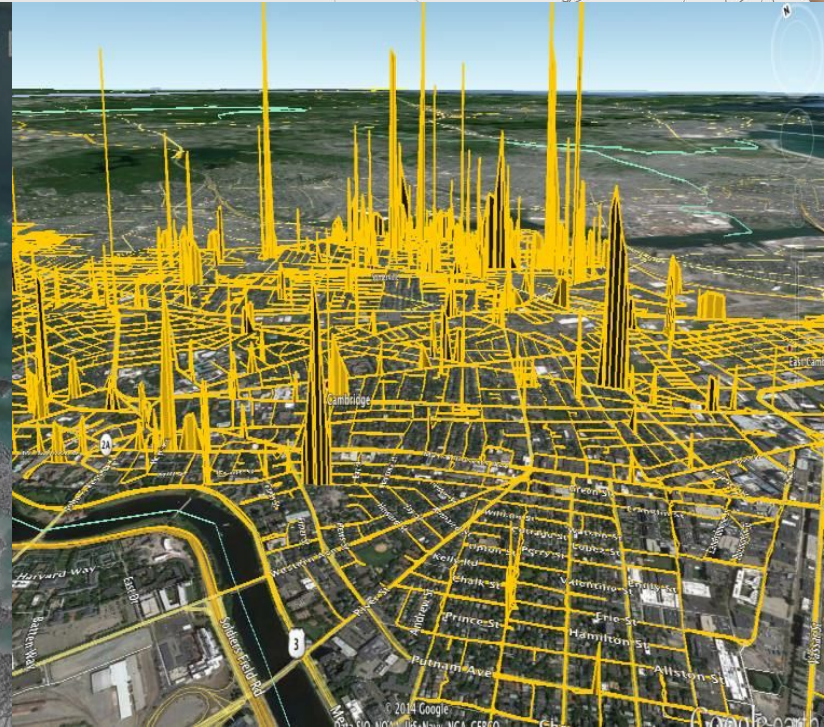
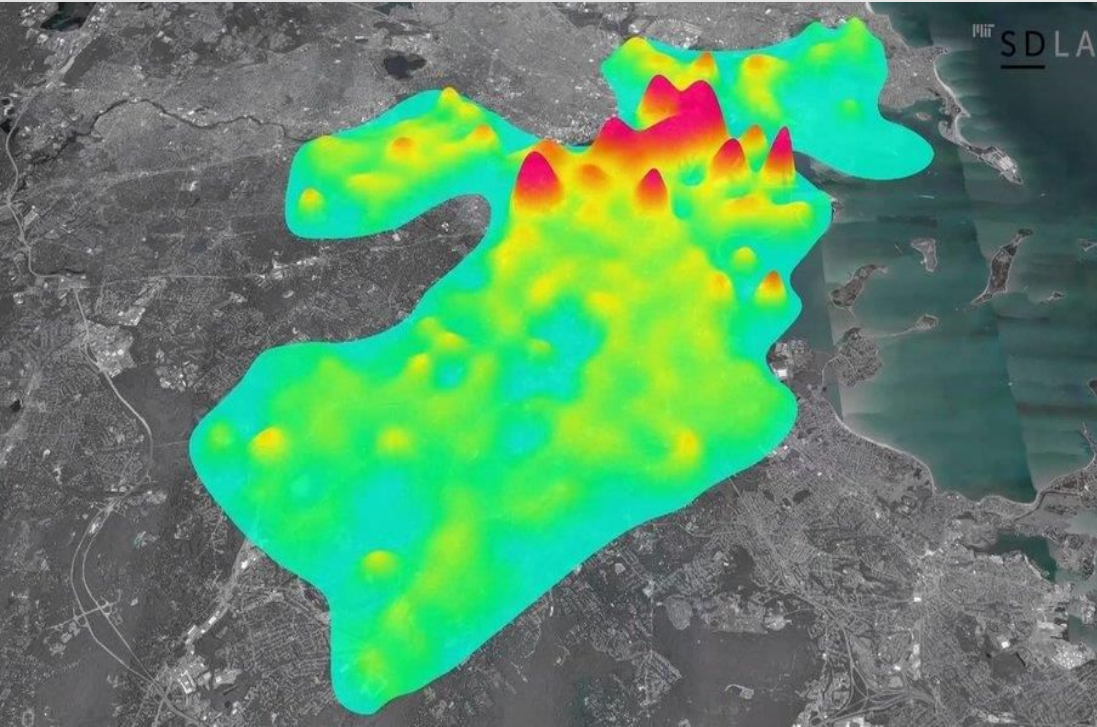
IP-S3 Mobile Mapping System:



# Monitoring performance across the city – via the model and linked dashboards



# Boston smart city heat and gas leaks map



<https://www.edf.org/climate/methanemaps/city-snapshots/boston>

<https://www.google.com/maps/d/u/0/viewer?mid=1u2rultCwcVDMepvD0PDrRfzv6n-jQcL4&ll=42.5168195912234%2C-73.20718368088725&z=12>





# LEEDS CITY DASHBOARD



Toolbox



Gallery

## Weather

5-day weather forecast for Leeds

Day Night

Tue 6 Jun



High: 13° Low: 10°

Heavy rain

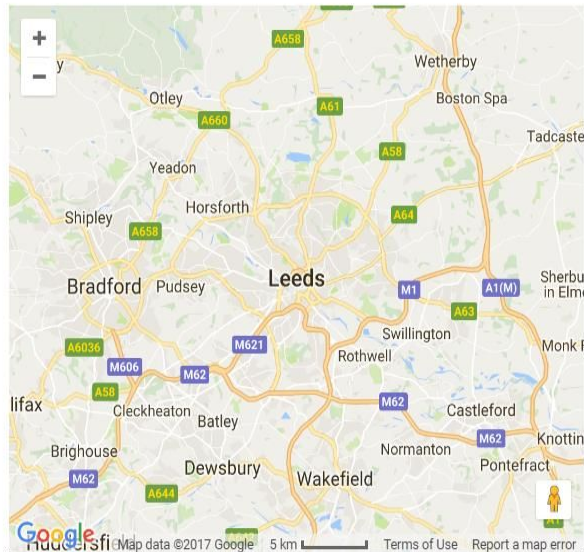
Chance of rain: 85% UV Index: 2 Humidity: 88%

Wind Direction: W Wind Speed: 20 mph

Author: Ste Allan

## Pedestrian Accident Locations

Concentrated locations of accidents involving pedestrians

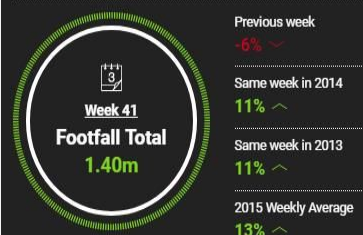


Author: Liam Bolton

## Leeds Footfall Trends

Weekly footfall stats for Leeds City Centre

Figures for the week commencing Mon, 3rd October 2016 and ending Sun, 9th October 2016.



Author: Simon Zimmerman

## FOI & EIR

Number of FOI & EIR Requests

Dec-14

FOI & EIR Requests received

95



Response time



Full Disclosure	Partial Disclosure	Withheld
19	81	11

Author: Nathan Smith

TUESDAY

6 TH

JUNE 201



## Leeds Data Mill Twitter Feed

What are we tweeting about?

DATA MILL NORTH @DATA MILL NORTH

Nice shout out to the work we're doing at

@DataMillNorth, thanks @techUKCEO

@ComputerWeekly. <https://t.co/olrgeCTffl>

## Leeds Car Parks

Registered spaces available in Leeds

Albion Street

P Albion Street

## Leeds Inspired

Music & art events around Leeds

## Multi-Sensory Social Extra

5 Jun 2017 10:30am - 12pm

### Room 700, Leeds Central Library

A multi-sensory social gathering where new parents can get together in a relaxed yet stimulating environment with their babies. Enjoy light show projections, sound effects, objects to feel and evocative smells to explore. The session will conclude with gentle stories and rhymes. Suitable for pre-crawlers, not suitable for



Author: Nathan Smith

## Statutory Notices

Newly added in Leeds

Statutory notices are legally required public notices which inform residents of proposed changes about specific things.

16 566

Licensing Planning

View Stat Notices

Author: Nathan Smith



Smart City



Community



Social



Economic



Ecological

Location  
based  
approach



Digital Twin



Geospatial Data | Spatial Data | Sensor Data | Data

# Connecting infrastructure: all roads lead to the **Digital Twin**

WHAT IS  
DIGITAL  
TWIN?



Developing a **digital twin**: a **virtual model** of the infrastructure which will both

**monitor infrastructure in real-time**

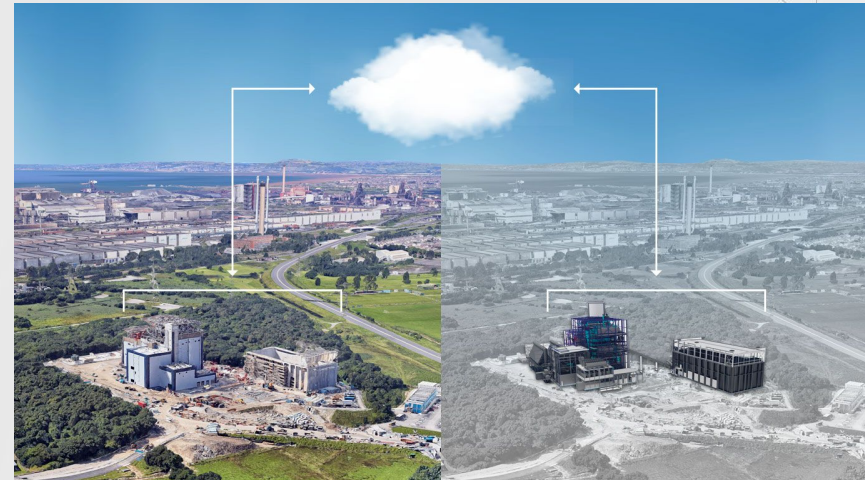
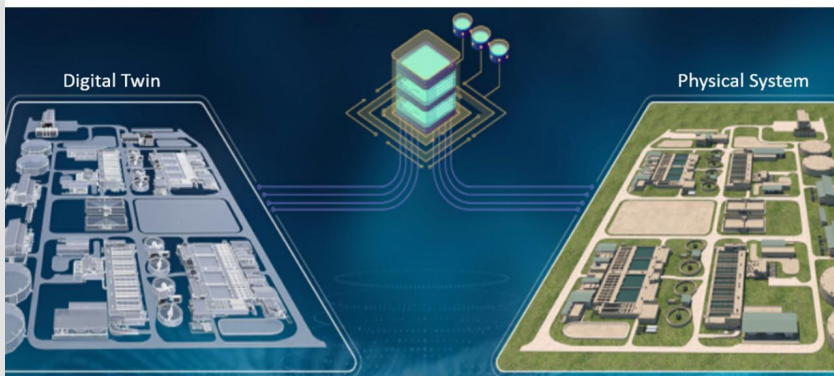
and have **predictive capability**.

This will help **manage, plan, predict and understand** the infrastructure, delivering resilient, responsive, high-performance systems.

Three demands for useful and modern digital city twin

- It's available through **open** interfaces
- It's up-to-date **all the time**
- Extensive data content (not only buildings)

**3d Digital Model with Intelligent Data**  
**Is essential For Smart Cities**



## “the Digital Twin”

A digital version of the real world including **physical assets indoors**, outdoors, above and **below ground**.

An integrated approach -multiple contributors, multiple geometries

enables **scenario modelling**, simulation and analytics

**Dynamic and linkable** representations of real-world features, supported with strong, **persistent identifiers**.

Machine **readable content**, integrated with other views of the real world

“The best way to predict the future is to create it.”

Abraham Lincoln

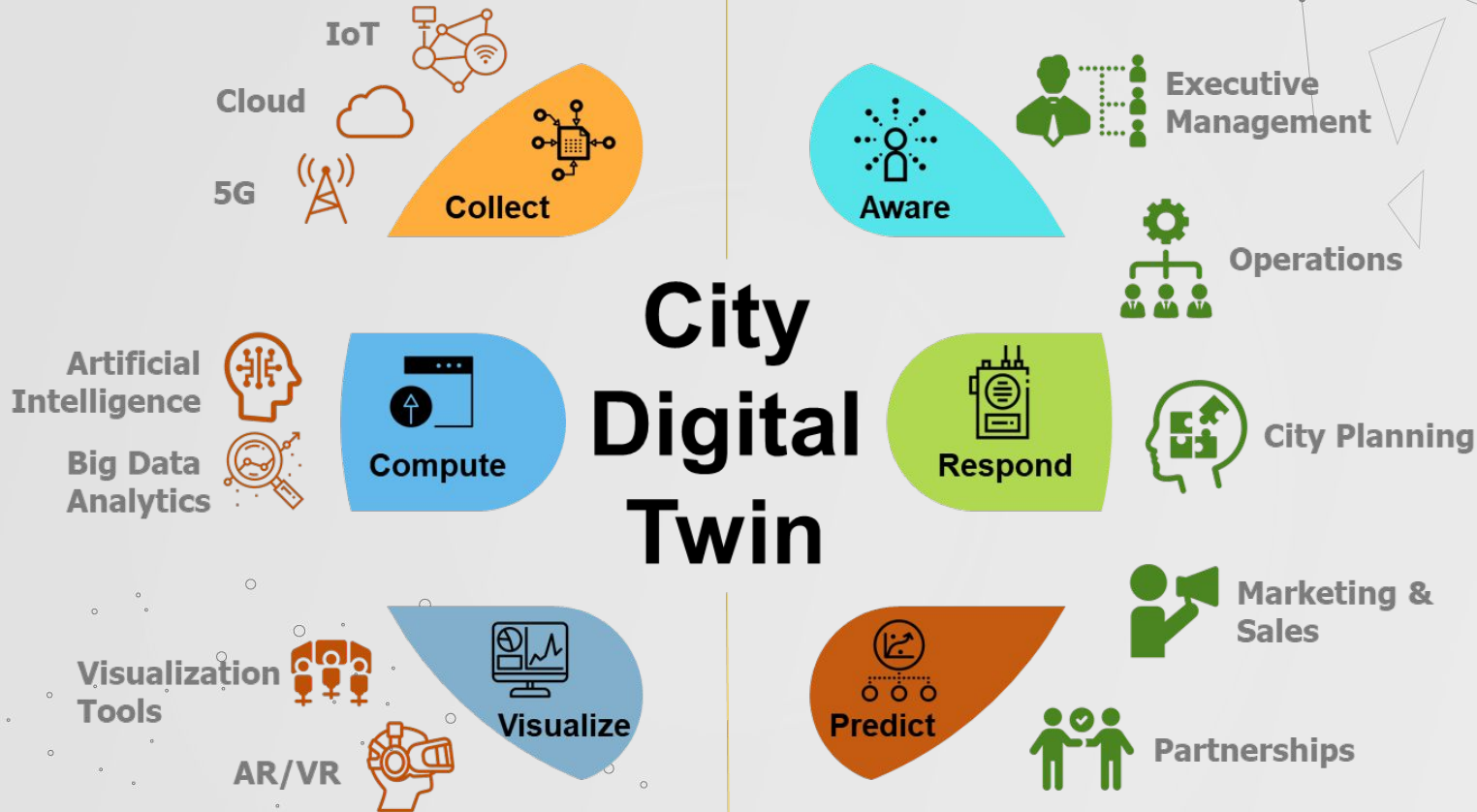


virtual model of London



Operations

Technology



# Orbit 3DM Content Manager

## AN INDISPENSABLE STEP IN THE 3D MAPPING DATA CHAIN

Organize & manage

Catalog & Archive

Improve & optimize image and point cloud data

QA/QC

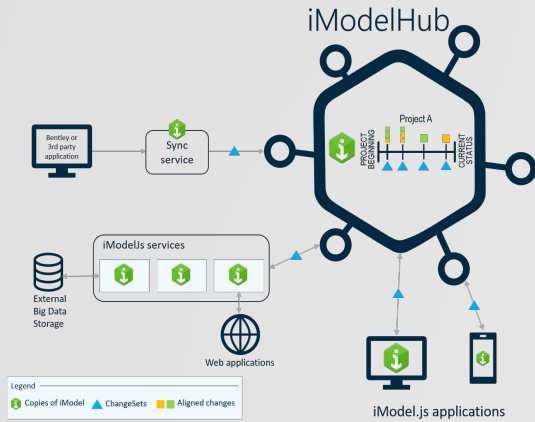
Document and report independent

Deliver ready-made projects after capture

Upload to share online

**FEATURES DOCS & DOWNLOADS**





<https://www.itwinjs.org/>

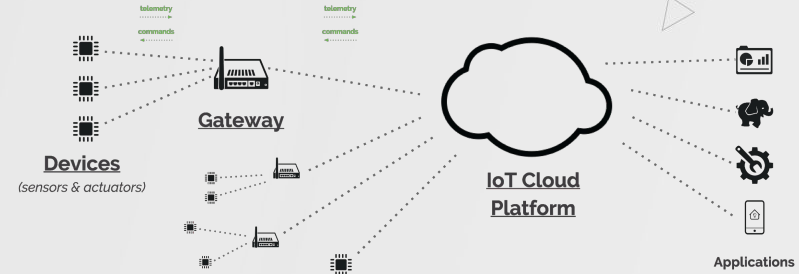
open platform for digital twins



asset management solutions



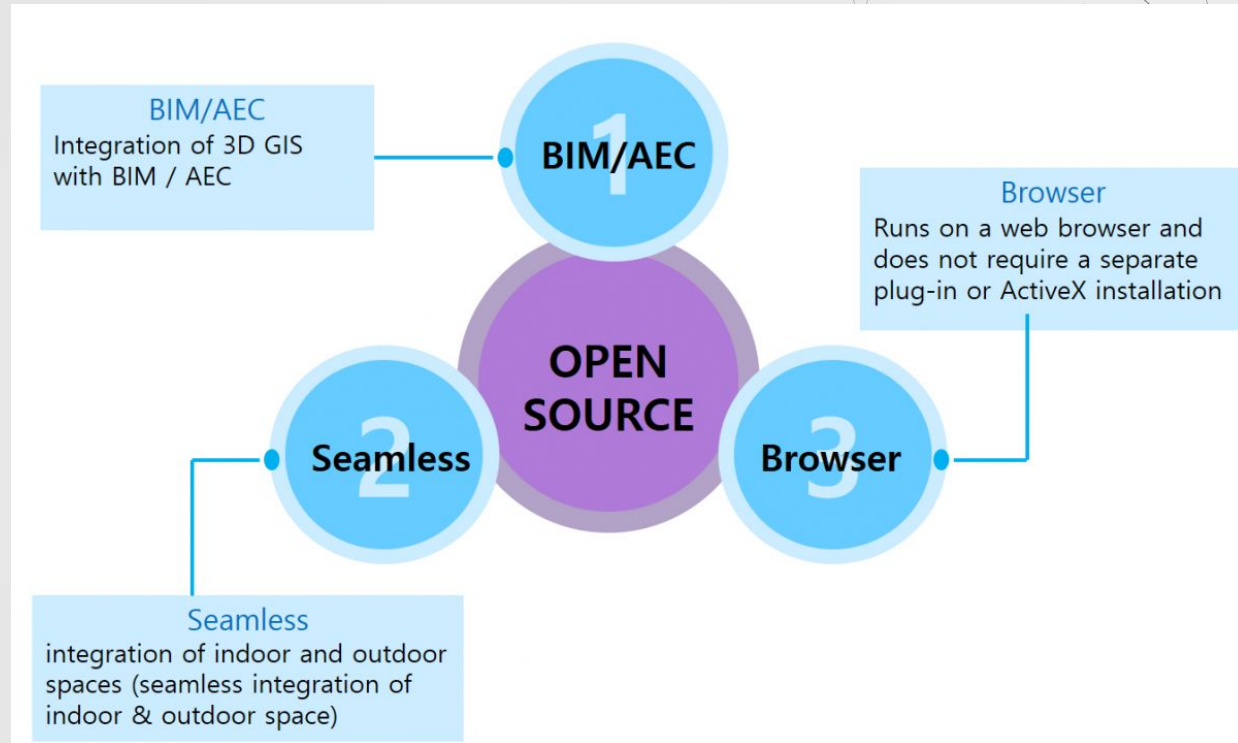
AssetWise - Asset Information Management Software



iot sensor platform and devices



# mago3d



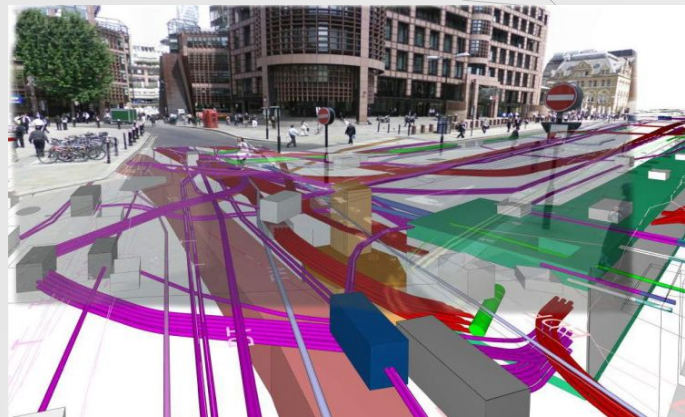
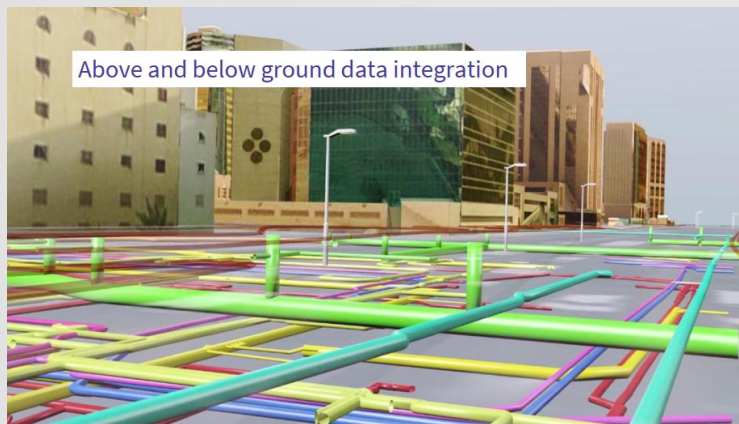
<http://www.mago3d.net/homepage/demo.do?viewLibrary=worldwind&lang=en>

Oliot is aiming an international standard based **Internet of Things (IoT) Infrastructure Platform**, by extending the code system of GS1 and their standard architecture to support various IoT connectivity and protocols such as bar code, 2D DataMatrix, QR Code, RFID, ZigBee, 6Lo, Bluetooth Low Energy, OneM2M, OCF, etc. Oliot also aims a complete implementation of GS1/EPCglobal standard.

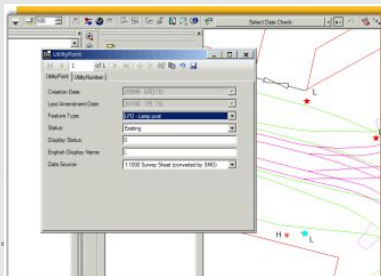
# Internet Of Things







## Use Artificial Intelligence (A.I.) for mapping



Conventional Feature Extraction  
by Coding



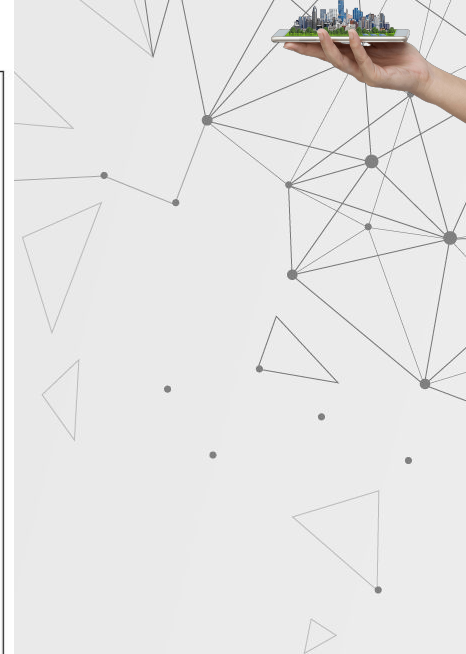
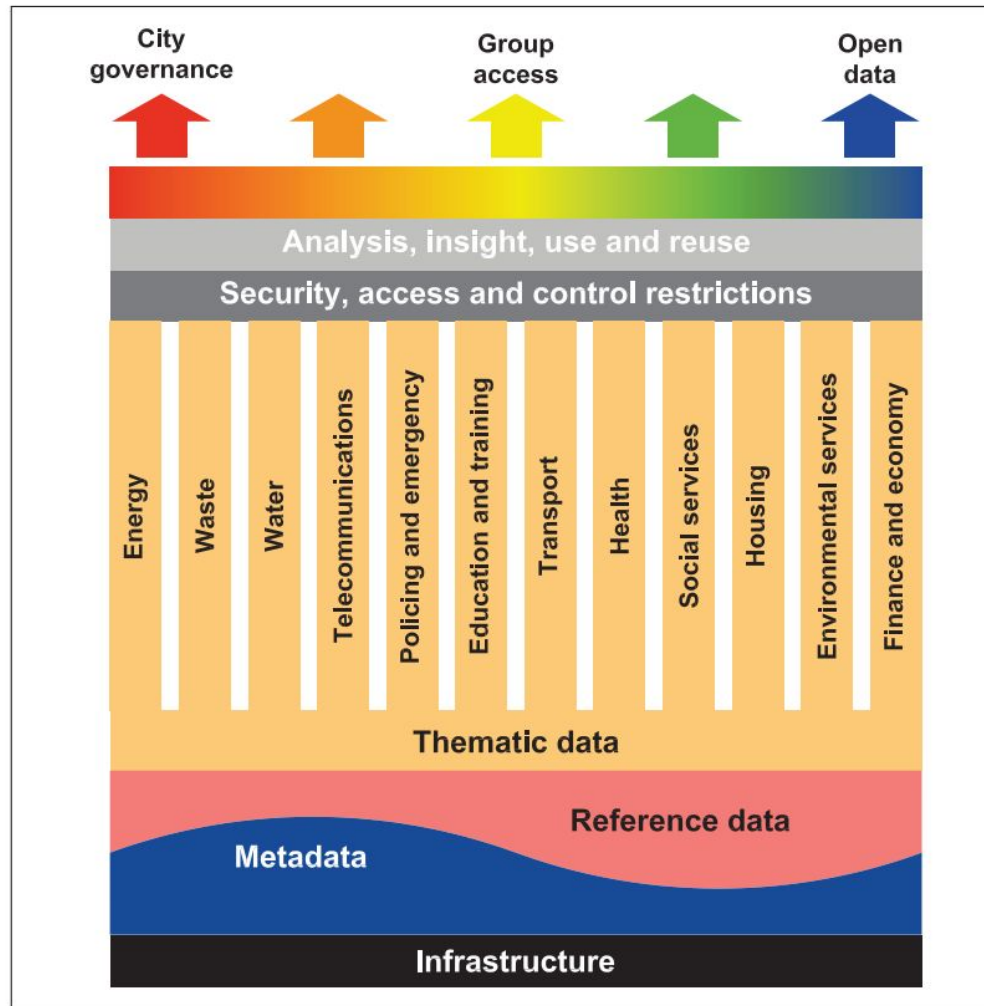
Automatic Feature Extraction by A.I.

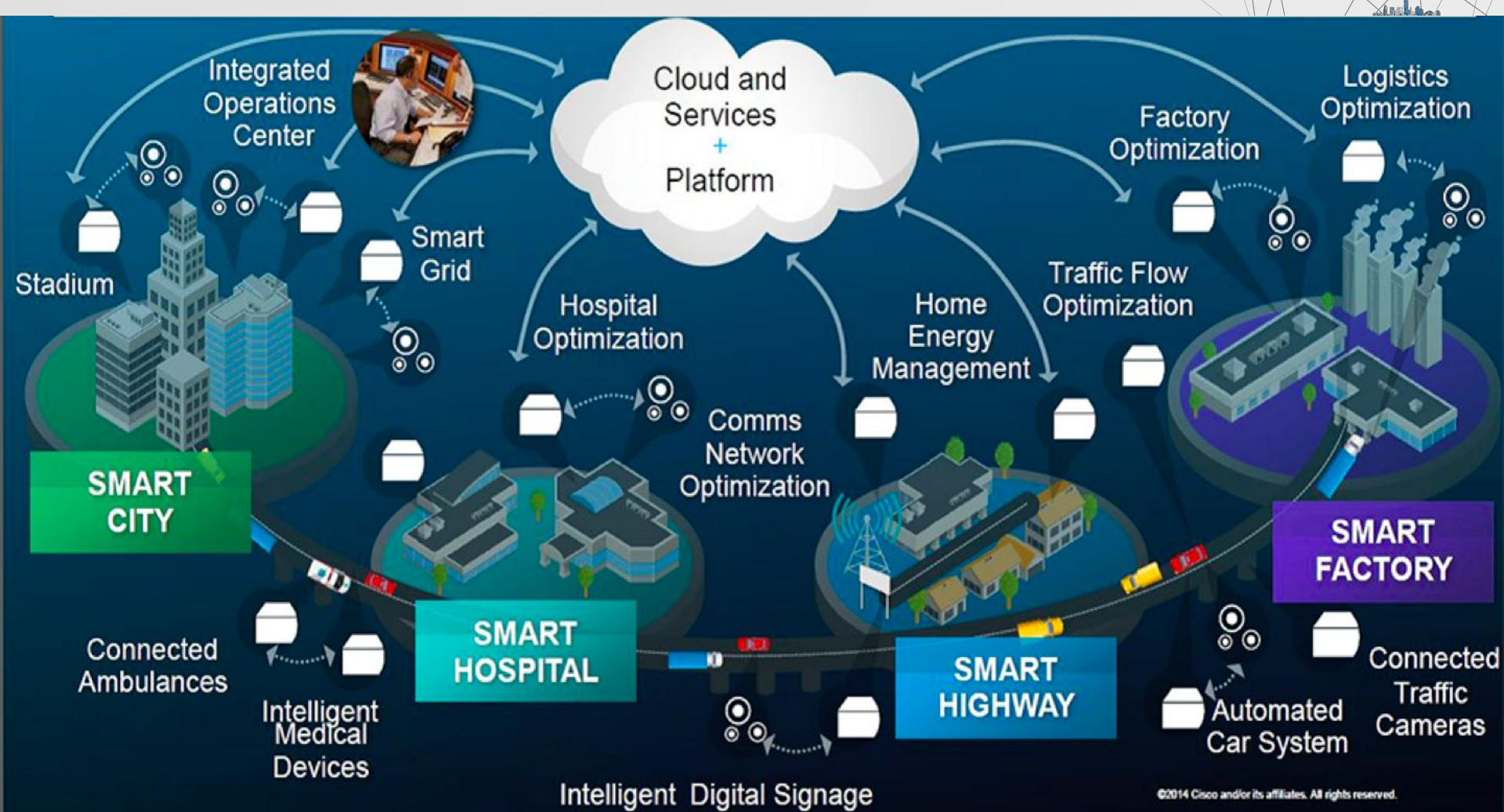


## There're basically and originally differences between BIM data and GIS data.

BIM data	GIS data
objects of Buildings	Objects on the Earth
Walls, Pillars, Floors, Windows, Doors, etc.	Roads, Buildings, Mountains, Trees, etc.
Usually created by Human	Usually generated via surveying(and processing)
.RVT, .IFC, and so on .	SHAPE, .GEOTIFF, and so on

## Data framework









City government  
More efficient city  
management



City residents  
Services and  
information



## Integrated city management platform

### Supervision and coordination

Information  
sharing

Incident  
management

### Management and optimization

Business  
intelligence

Decision  
support



Traffic  
management



Public  
transport



Electric  
vehicles



Events and  
emergencies  
management



Weather and  
emissions



Security

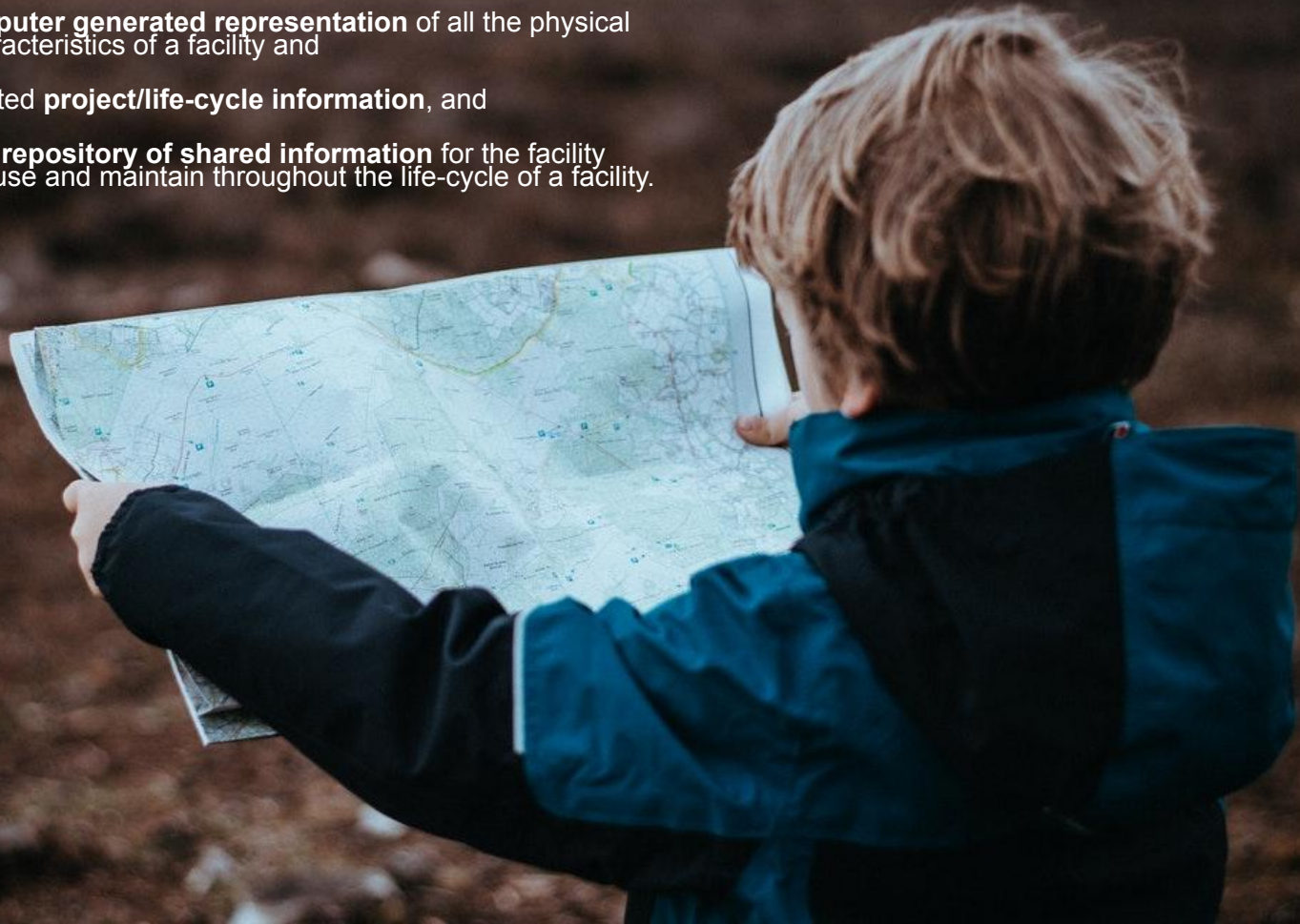
Integrated city management platform

Building Information Model : A Building Information Model or BIM utilizes cutting edge **open standard digital technology**

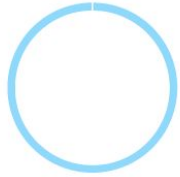
to establish a **computer generated representation** of all the physical and functional characteristics of a facility and

to establish its related **project/life-cycle information**, and

is intended to be a **repository of shared information** for the facility owner/operator to use and maintain throughout the life-cycle of a facility.



# How are we using 3D Models?



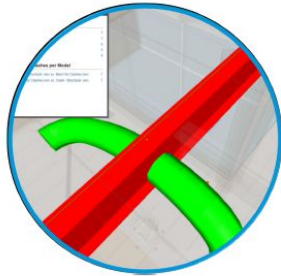
## VISUALISATION



- Design / Drawing Production
- 3D Details
- CGI
- Virtual reality



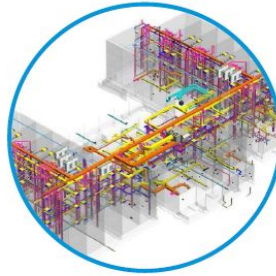
## CLASH DETECTION



- Clash avoidance
- Cost Avoidance



## MODEL COORDINATION



- Digital Twin
- Fully coordinated 3D Project



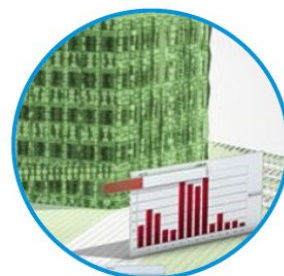
## 4D MODELLING



- Construction Simulation
- Logistic

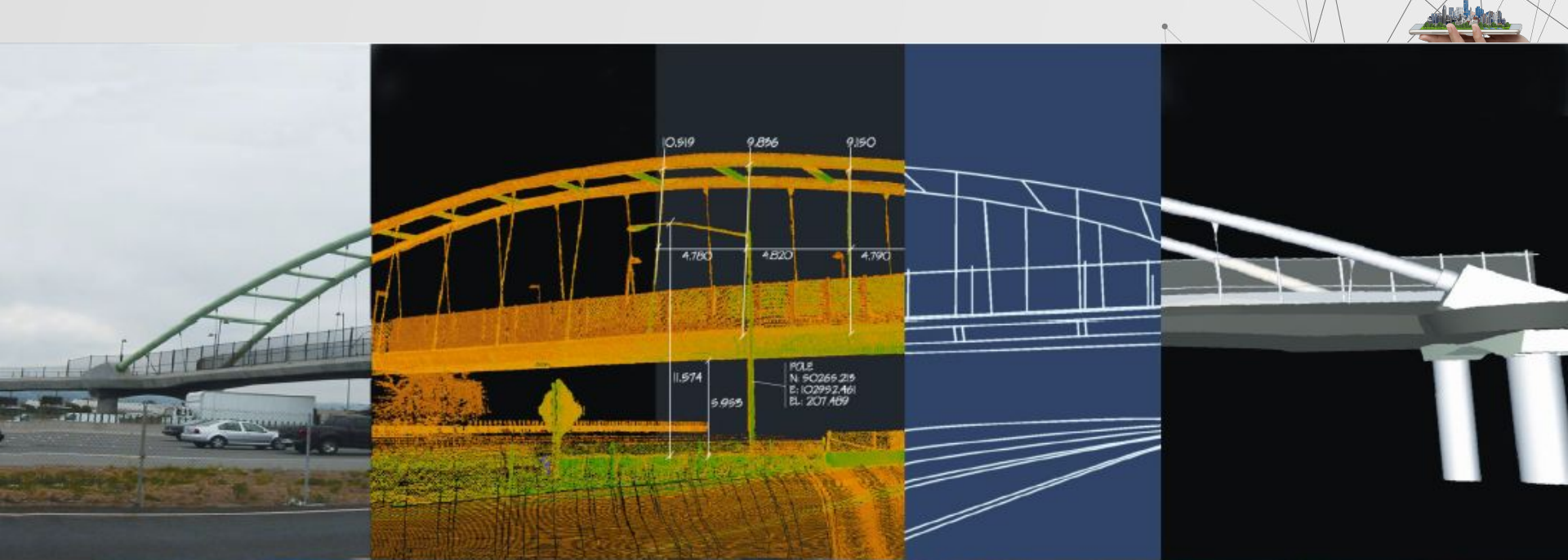


## 5D MODELLING



- Quantity take-off
- Costs





**Georeferenced  
Hi-res Digital  
Images**

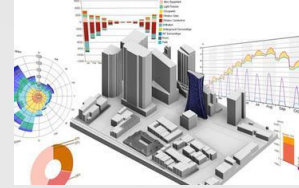
**3D  
XYZ Return  
LAS Point Clouds**

**2D -3D Feature Lines  
3D DTMs-TINs  
X-Sections**

**3D  
CIM-BIM  
DSMs**

# BIM

- BIM stands for **B**uilding **I**nformation **M**.....
  - **Model** (smart **composition** of **objects + information**)



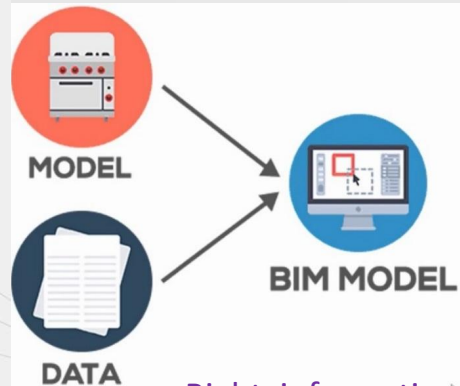
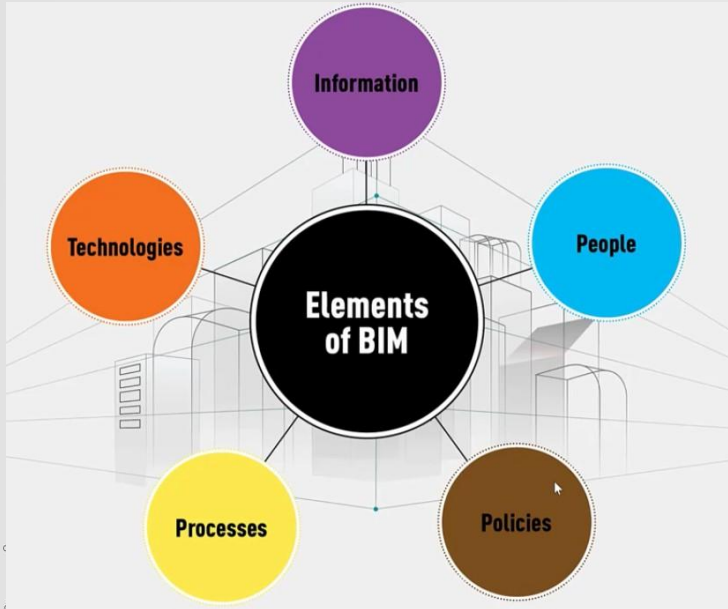
## - Modeling

The **process** of **Sharing** information about building ,

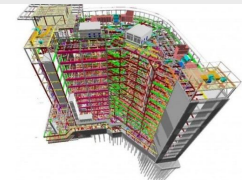
**Defining** the **Execution Plan Implementation** the process of the **C D E**.

-begins with **creating** an intelligent 3D design model

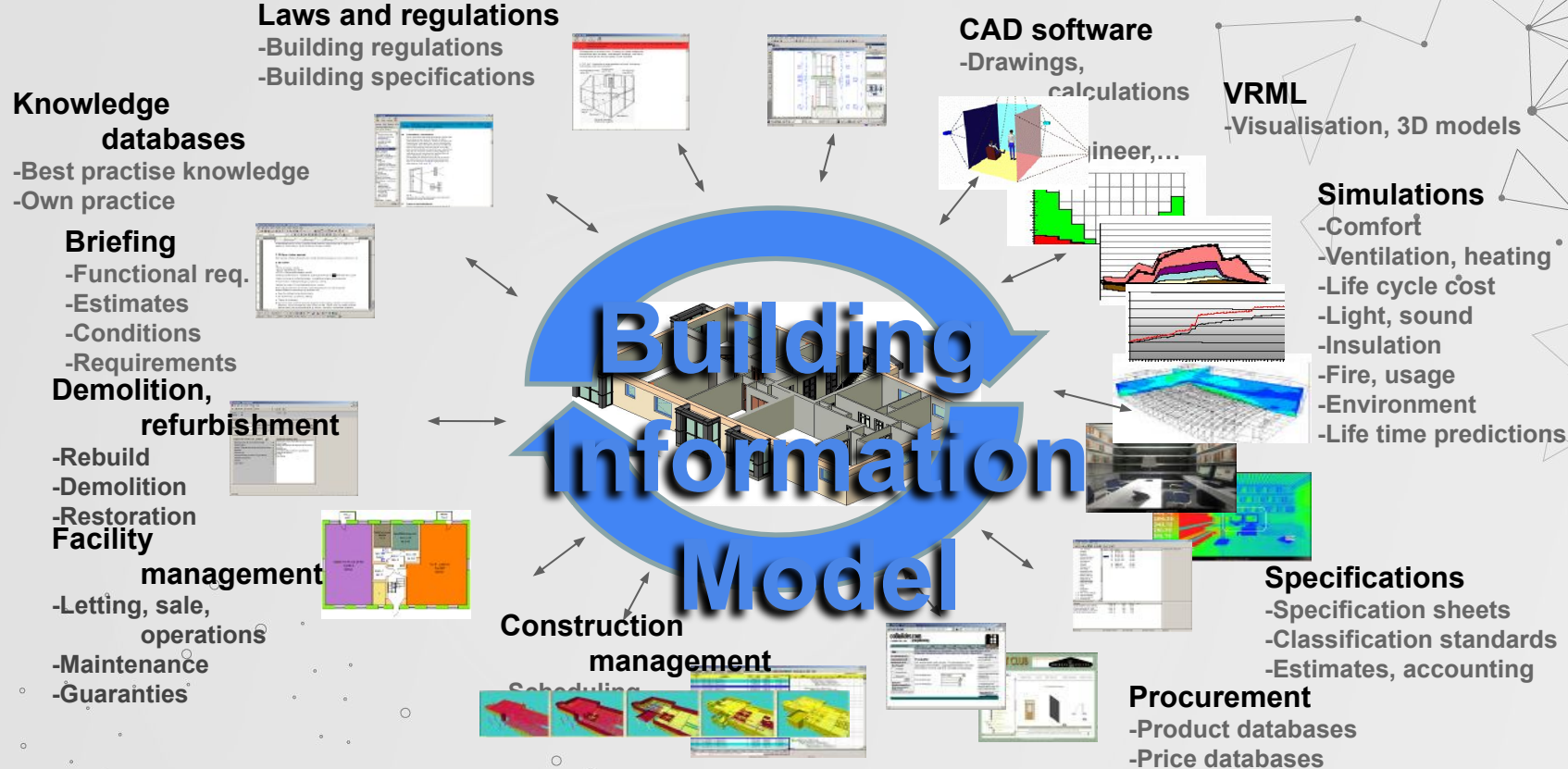
-**uses** that model to **facilitate** coordination, simulation, and visualization,  
- **helping** owners and service providers **improve how buildings and infrastructure** are planned, designed, built, and managed.



**Right information,**  
**in the right form,**  
**from the right person,**  
**at the right time**



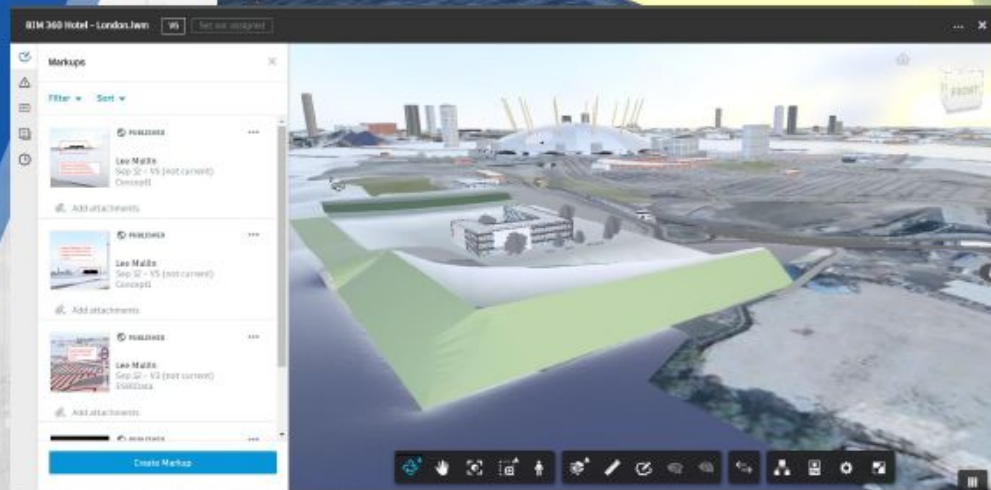
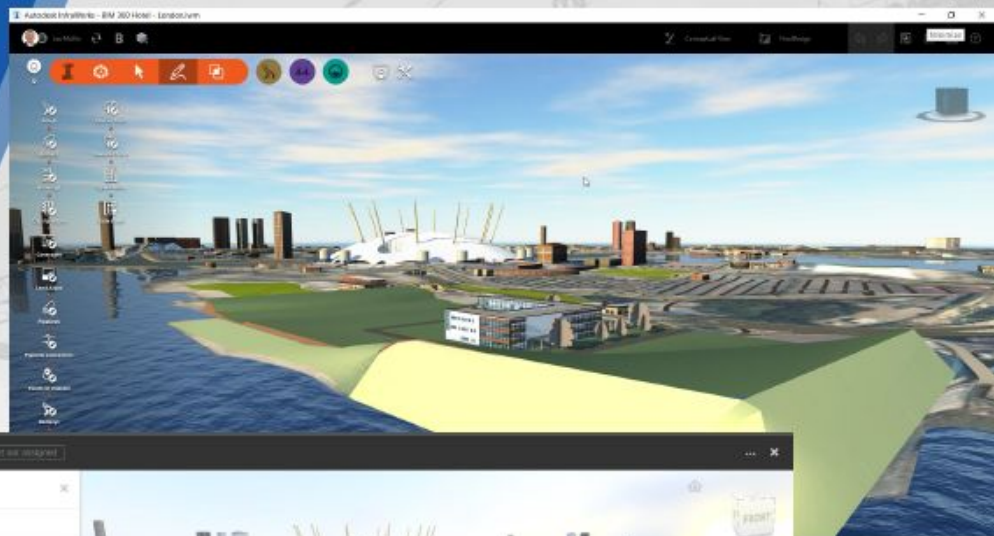
# Lifecycle Information View



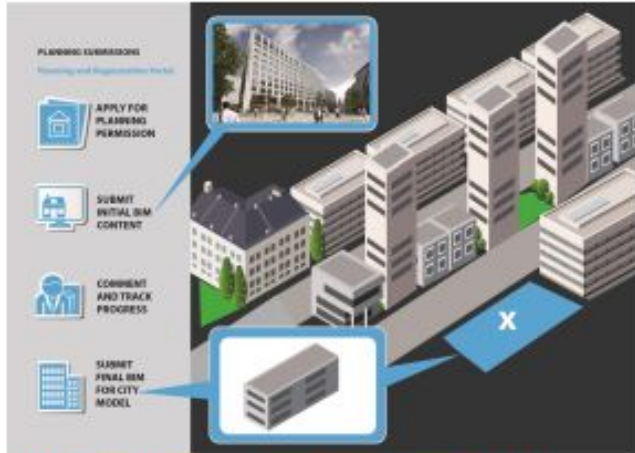


# VIEW MODEL IN CONTEXT

- Load Revit model published into BIM 360 into Infraworks for context
- View different landscaping and traffic scenarios
- Create Markup and Issues on the design in context



# Better more informed planning decisions using the model



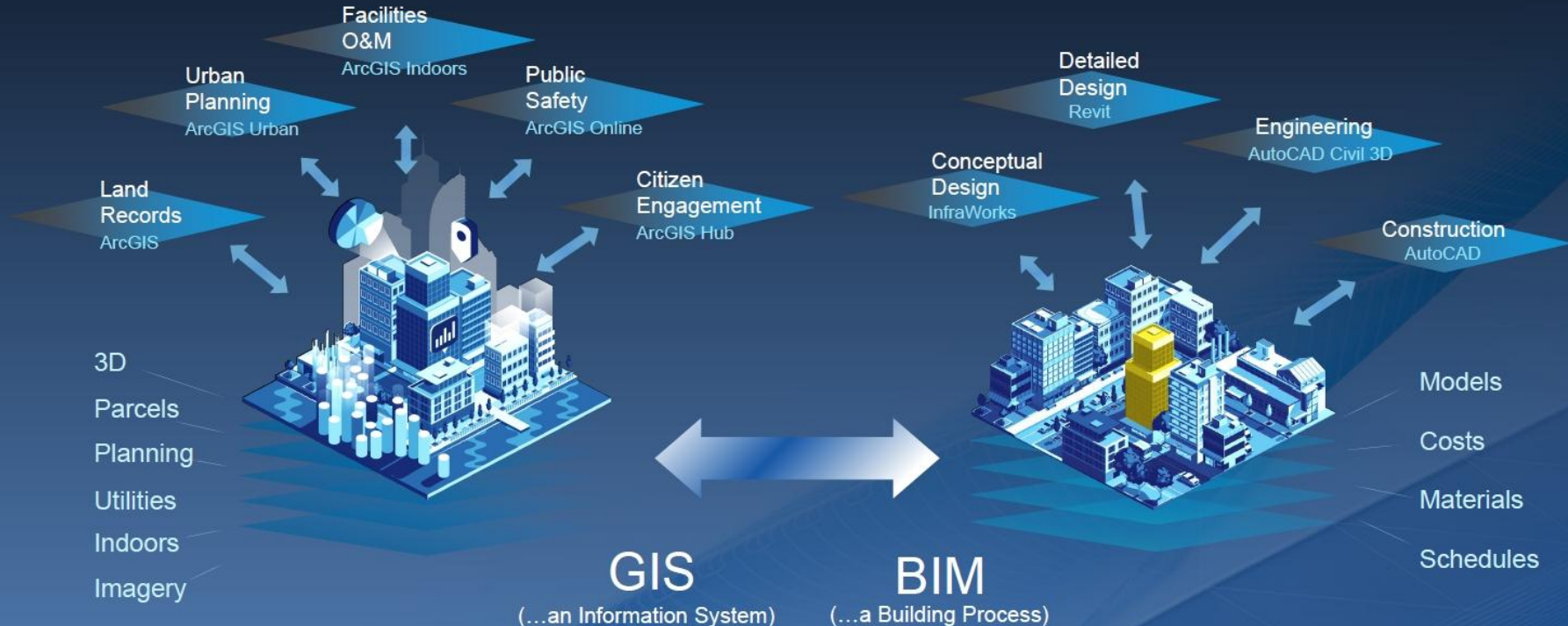
At planning the concept model is placed in the model



The model helps planners to understand the impact a development will have

# Smart Cities and Infrastructure with GIS and BIM

Technology integration leads to smarter more efficient cities



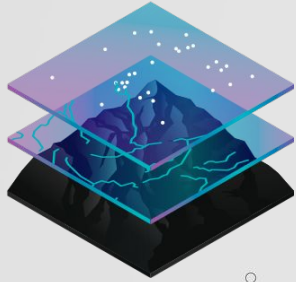


# BIM and GIS Workflows Are Happening Continuously in Smart Cities

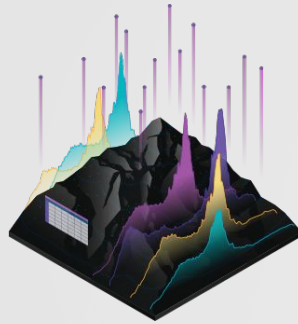


## Geographic Information System (GIS)

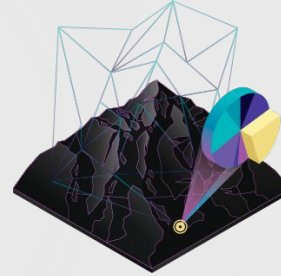
is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations—helping users make smarter decisions.



Maps



Data



Analysis



Apps

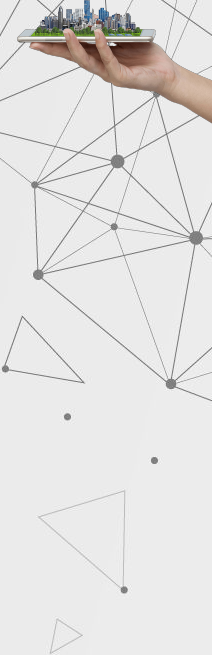
# What is CIM?

*“Civil Integrated Management (CIM) is the technology-enabled collection, organization, managed accessibility, and the use of accurate data and information throughout the life cycle of a transportation asset. The concept may be used by all affected parties for a wide range of purposes, including planning, environmental assessment, surveying, construction, maintenance, asset management, and risk assessment.” -FHWA, AASHTO, ARTBA (2012)*

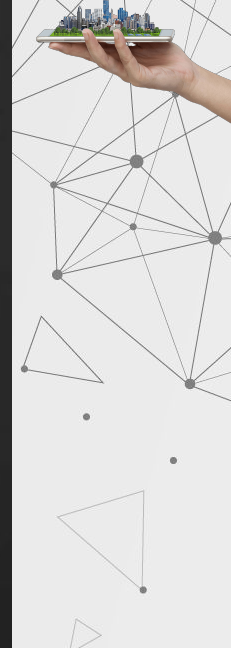
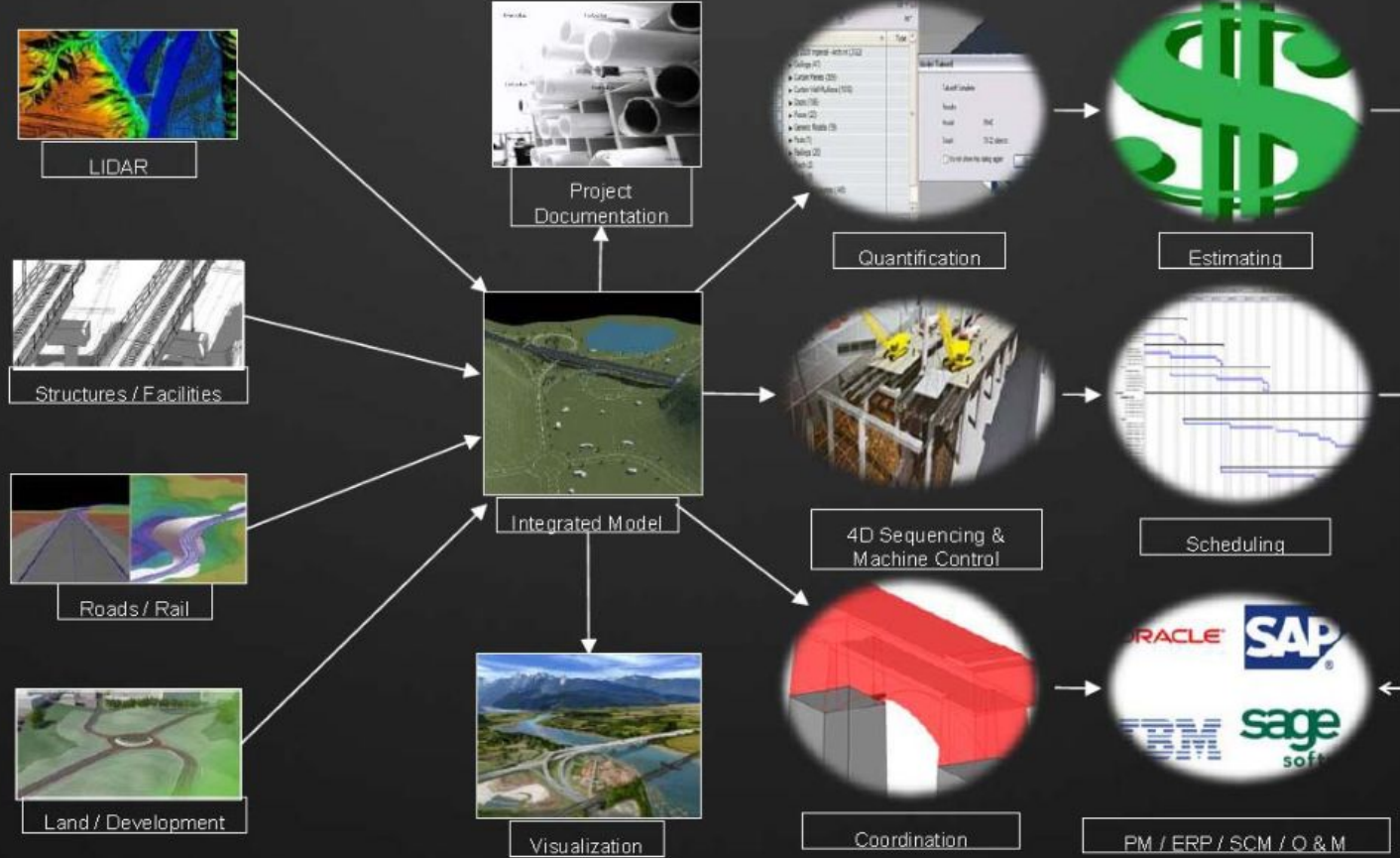
- **Why use CIM?**
- *CIM can have great benefits in cost and time savings on projects*
- *CIM can improve information flow*
  - *Transparency among project stakeholders*
  - *Improve outreach to the public*
- *CIM can increase the effectiveness of agency professionals and service providers*
  - *Breach traditional silos*
  - *Improve information quality and availability*
  - *Increase productivity*
  - *Improve interfaces with contracted professionals*







# Heavy civil construction projects – BIM + geospatial



# BIM for Sustainable Cities

Planning, Site Selection,  
Conceptual Design



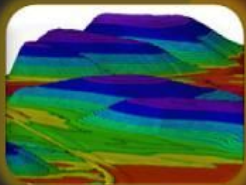
Surveying and  
Data Collection



Multidiscipline  
Coordination



Simulation  
Analysis



Modeling &  
Design



Construction  
Documentation



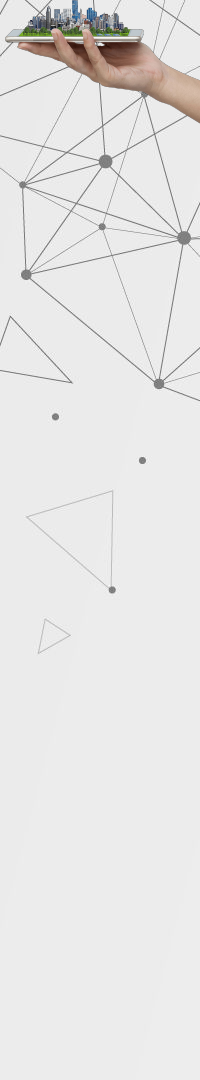
Visualization



Op. & Maint



Construction  
Management





# INTERNET OF THINGS IN CONNECTED CITIES

## TRANSPORTATION CONGESTION SENSORS

Smart transportation systems use sensors to detect congestion and bottlenecks in traffic patterns. They also rely on cameras to enforce speed and traffic infractions. In doing so, these tools gather real time information that can be used by city DOTs to make mobility networks safer and more efficient.

## WATER AND WASTEWATER MONITORING

Monitoring devices can detect leaks as well as changes in water pressure to determine whether water infrastructure is working properly.

## PARKING APPS AND KIOSKS

Apps coordinate with smart parking meters to inform drivers of where there is parking availability.

## BRIDGE INSPECTION SYSTEMS

Sensors monitor the structural soundness of bridges and inform city engineers of any issues. Drones are used to inspect hard to reach areas.

## SELF-DRIVING CARS

Self-driving cars shuttle people in and out of the city, providing rides for others and making deliveries while their owners are occupied with work or other activities.

## WASTE MANAGEMENT SENSORS

Sensors detect the amount of garbage in receptacles around the city so that sanitation workers can maximize efficiency in their routes.

## LIGHTING

LED lights are weather adaptive and communications are automatically sent to the Department of Public Works when the bulbs need to be changed.

## FIRE DETECTION

Sensors monitor conditions in public parks and wooded areas that might be prone to fire. Sensors can also detect fires in buildings and initiate a call to the fire department in an emergency.

## ENERGY MONITORING

Power plants can be monitored for safety and city officials can be informed of any influx in radiation levels.

## SOLAR PANELS

Solar panels can be monitored to determine how much energy they are providing and whether they need maintenance.

Every consumer product and piece of infrastructure increasingly has the ability to sense surrounding stimuli, to communicate with other devices and people, and to draw on the computing and storage power of the cloud. This phenomenon has been dubbed the **Internet of things**. The more smart devices

and sharing platforms there are, the more data is generated about consumer's preferences and habits. But what does this mean for cities? Smart cities are employing the same technology to connect their disparate utility, infrastructure, and public service grids, generating real-time aggregate data. This, in turn, can

help cities manage their programs and services more effectively and gauge their impact immediately. The city of the future is an interconnected one, where devices communicate with one another in a constant stream of data that provides real-time information to the public and to the municipality.

## DRONES

Drones can be used for law enforcement and firefighting, as rural ambulances, for infrastructure inspections, and for environmental monitoring. Commercial uses include precision farming, aerial photography, and in the near future, package delivery.

## SURVEILLANCE CAMERAS

Cameras ensure security by monitoring activity in areas that are not frequented by public safety officers. Areas that are not open to public access can be monitored to keep unauthorized personnel out.

## BODY CAMERAS

Public safety officers can wear body cameras that capture footage of interactions between themselves and city residents to ensure safety for both parties.

## WEARABLE DETECTION

Cities can build in smartphone and wearable detection sensors so that people can be an active part of the internet ecosystem, communicating with the city, and with each other.

## BROADBAND INFRASTRUCTURE

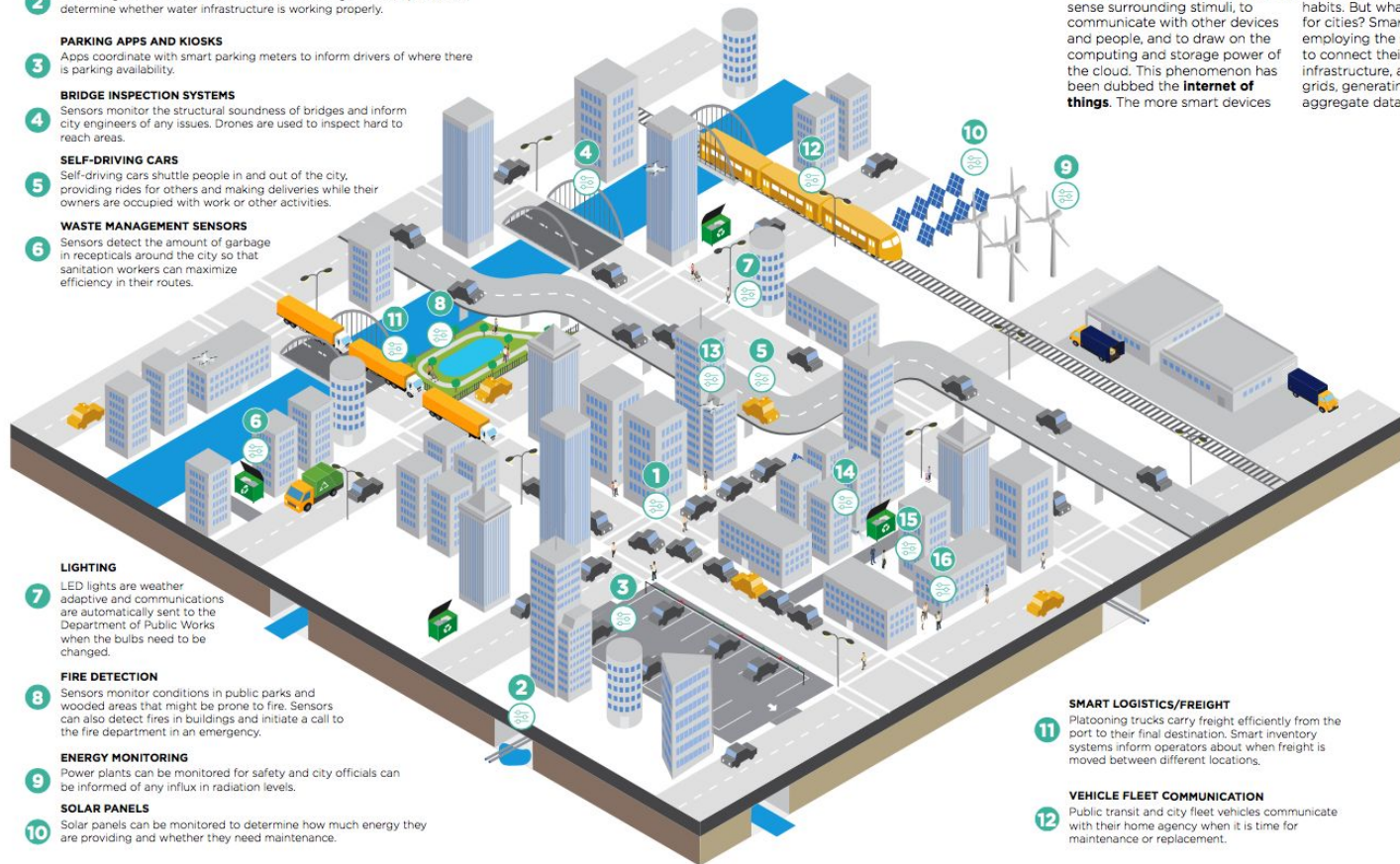
A reliable internet ecosystem is the glue that holds the internet of things together.

## SMART LOGISTICS/FREIGHT

Platooning trucks carry freight efficiently from the port to their final destination. Smart inventory systems inform operators about when freight is moved between different locations.

## VEHICLE FLEET COMMUNICATION

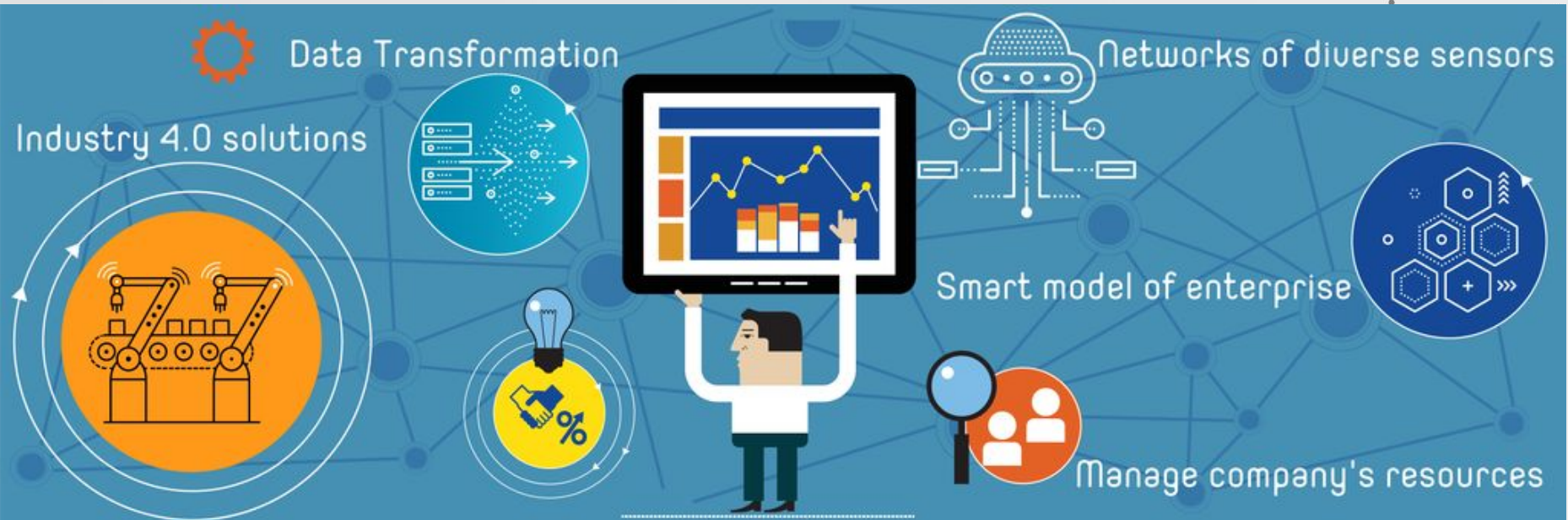
Public transit and city fleet vehicles communicate with their home agency when it is time for maintenance or replacement.



## Smart Enterprise Monitor

*enterprise Digital Twins driven by AI, Big Data and IoT to assist owners and operators in holistic management and control of complex business processes in manufacturing, services and distribution, condition monitoring to improve performance, efficiency and sustainability*

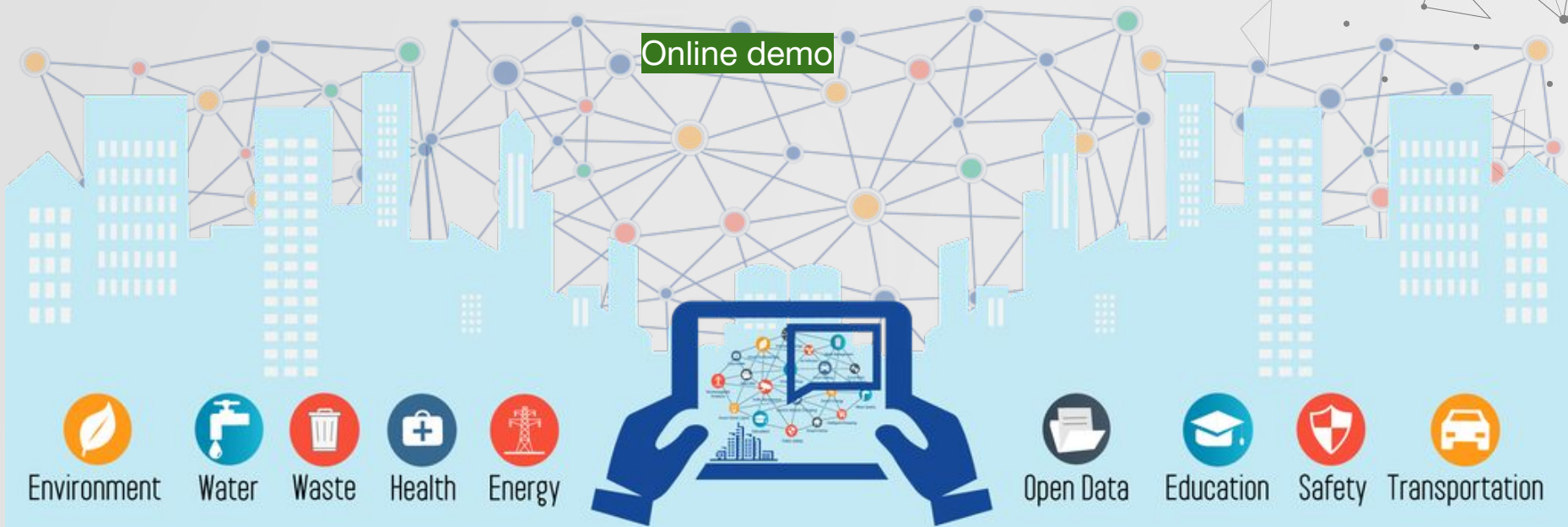
Online demo





# Smart City Monitor

*powerful Digital Twins for urban areas driven by AI, Big Data and IoT to assist governing bodies, administrations, utility providers and citizens improving quality of life, its sustainability, resource efficiency and transparency of processes and achievements*





IoT Integrator tools for rapid development of intelligent custom solutions

*tools for system integrators to make and run complex tailored IoT, AI and Big Data solutions*

*using big real time data from diverse sensors, automated systems and mobile apps in*

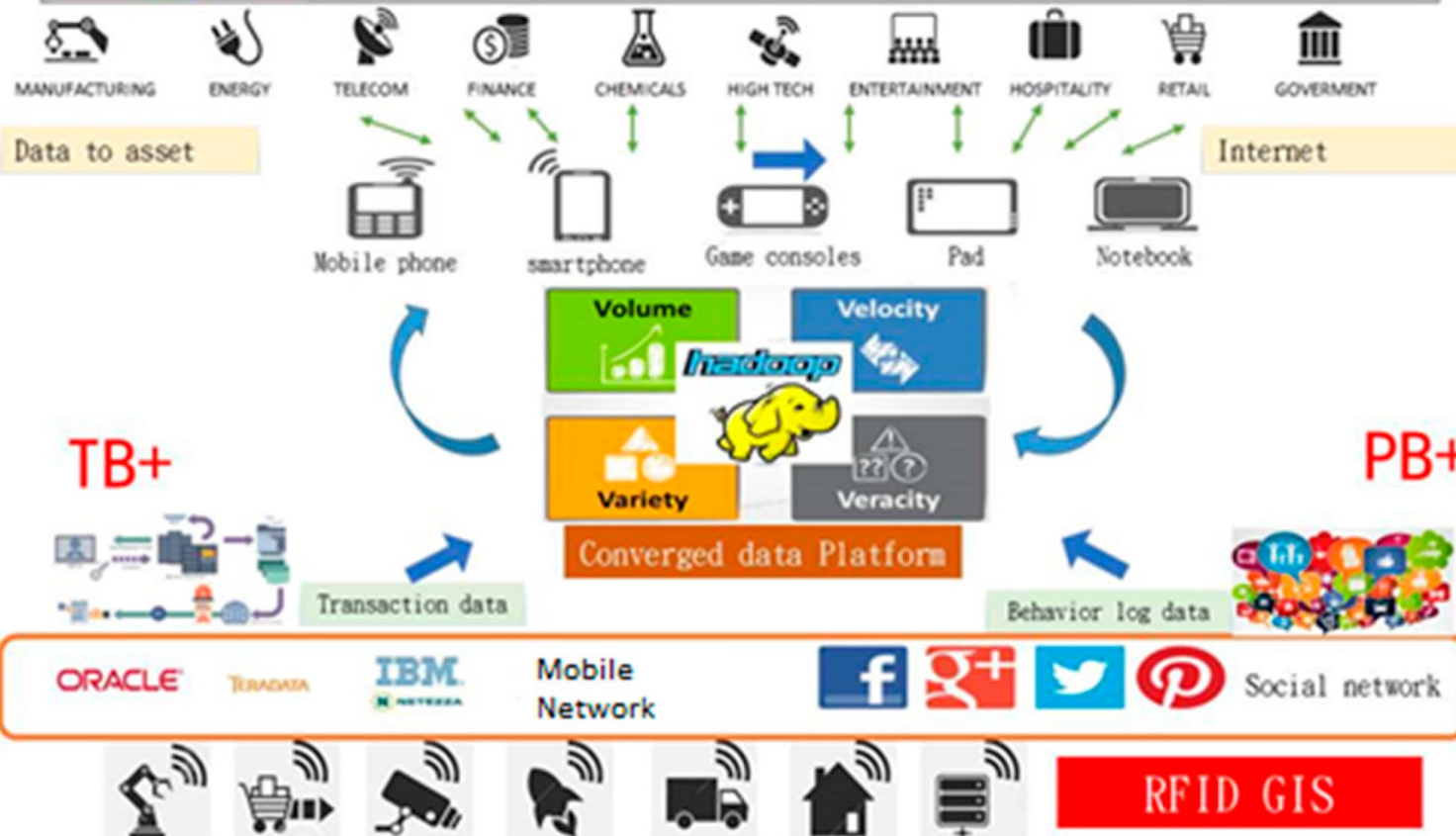
*physical and virtual worlds to provide customers with holistic monitoring and analytics*

Online demo





# I.O.C (Intelligent operations center)



Smart business

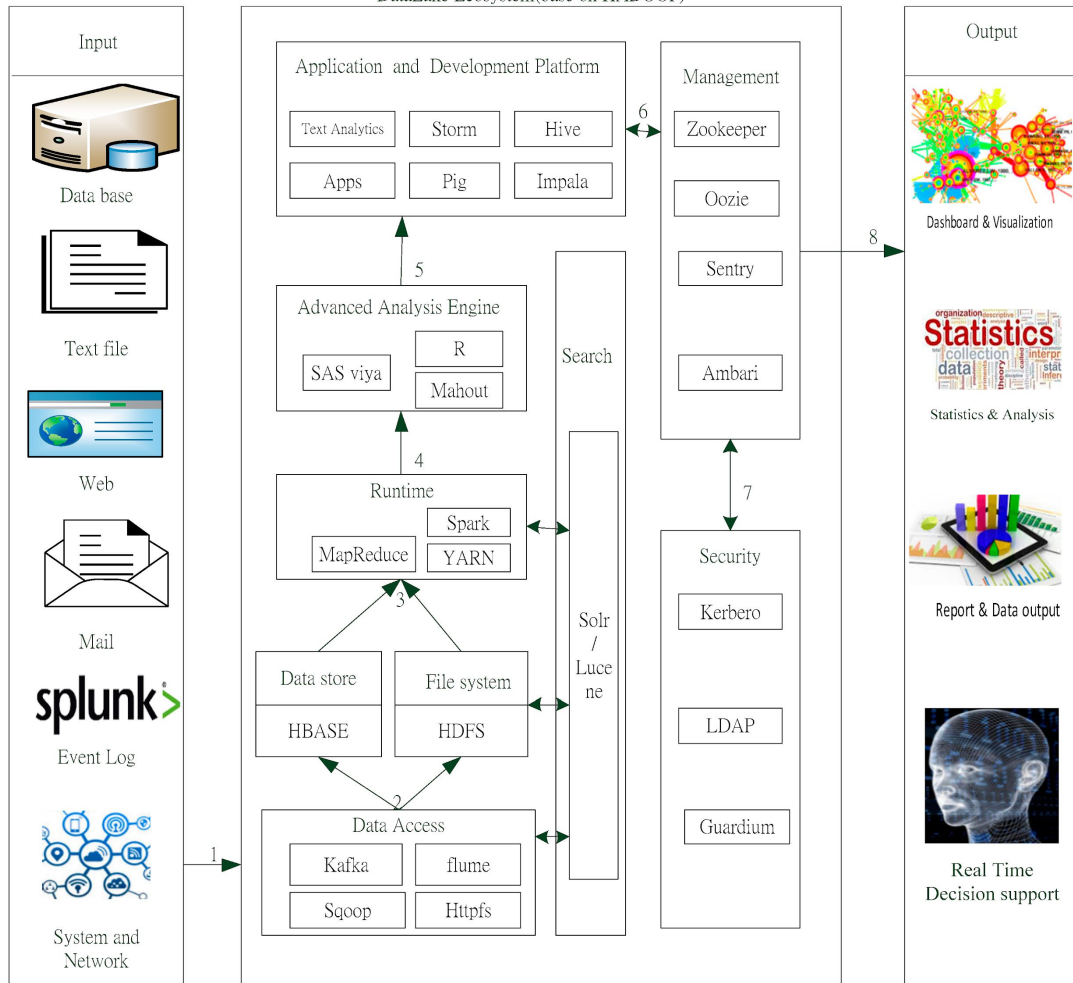
Mobile Network

Big Data

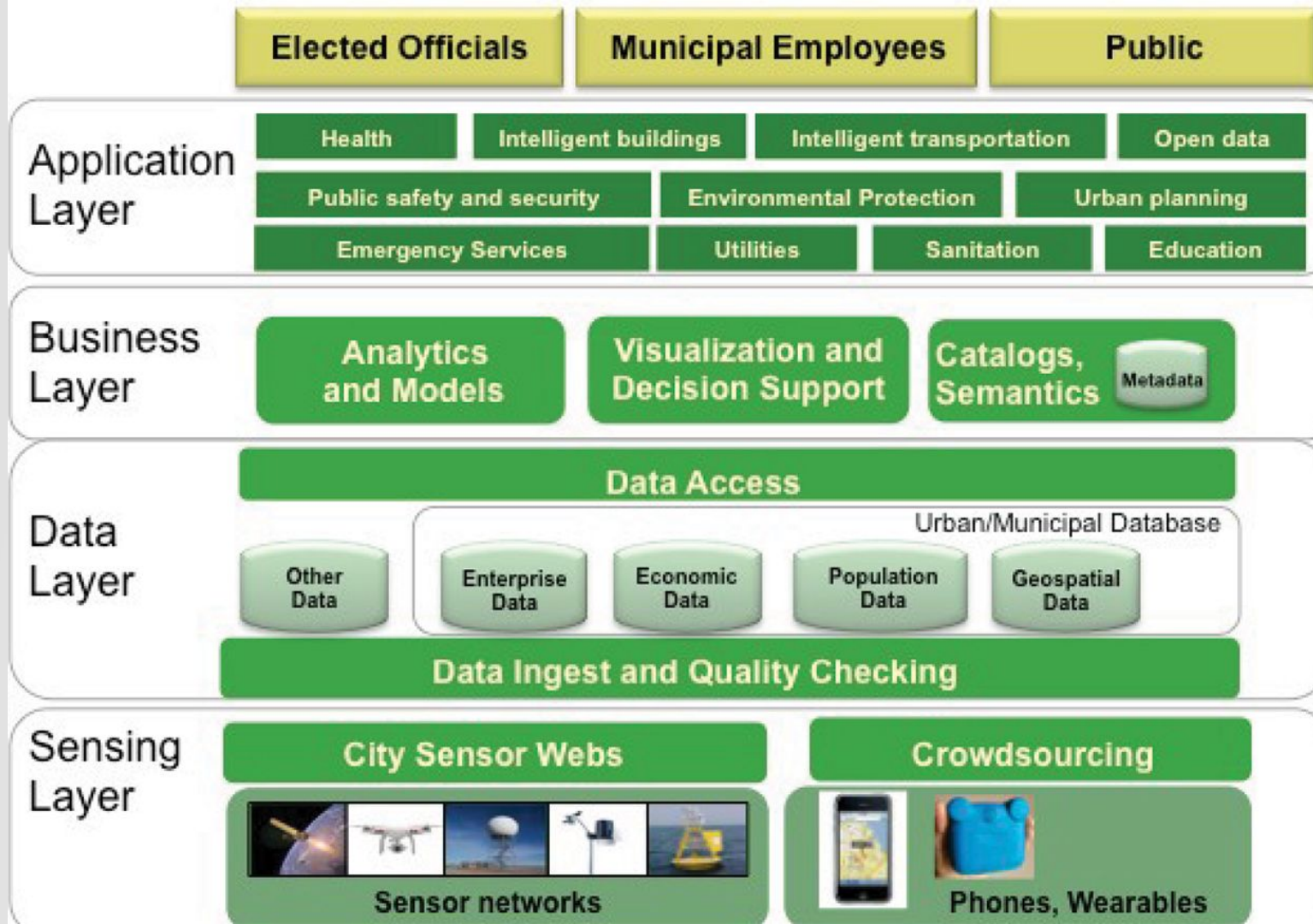
Cloud computing

Internet of Things

# Big Data DataLake Ecosystem(base on HADOOP)







Cloud hosted resources

Security System

# Open Street Map Egypt

- **Geo-data is not free**
- **In most countries you must pay the national mapping agency to license the data**
- **To buy the entire Ordnance Survey National database of the UK would cost £50 Million (€73 Million)**
- **"The OpenStreetMap Foundation is an international non-profit organisation dedicated to encouraging the growth, development and distribution of free geospatial data and to providing geospatial data for anybody to use and share."**



# What is OSM?

- Not software
- One world-wide geographic database with many contributors – “GeoWiki”
- Focus on streets – but also other features like land cover and POI
- Geometry types: Nodes, ways and closed ways (“areas”)  
Relations – group of geometries (Data Primitives)
- GPS-measured – quite good accuracy but not so detailed  
Stored in latitude/longitude – rendered in spherical Mercator projection
- Map Features with defined tags (common and extensible object model)
- Profiles like OpenCycleMap (specific tags and rendering)
- Open Geo Data
- There are many “free” basemaps, Google, Yahoo, Bing...
- ○ These only give limited rights of use
- OSM gives users rights to any kind of reproduction or processing
- Creative Commons license





# Methodology

People, like you and me, gather location data across the globe from a variety of sources such as:

- Recordings from GPS devices
- Public domain data
- Digitizing against free satellite imagery

This information then gets uploaded to OpenStreetMap's central database from where it can be further modified, corrected and enriched by anyone who notices missing facts or errors about the area.



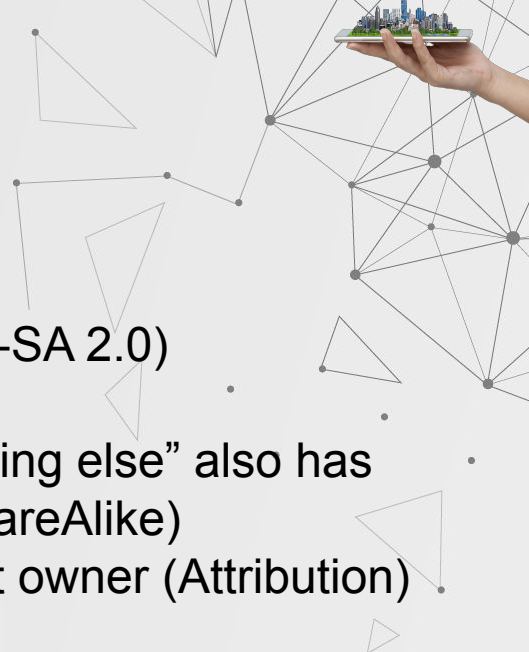
# Who owns OSM data?

Collaboration – the contributors are the owners, with the Creative Commons Attribution/ShareAlike license (CC-BY-SA 2.0)

- Anyone can copy OSM data
- But if you incorporate it into something else, that “something else” also has to be copiable under the same terms and conditions (ShareAlike)
- When you copy it, you have to give credit to the copyright owner (Attribution)

**Supporting, not controlling:**

• OpenStreetMap Foundation, [www.osmfoundation.org](http://www.osmfoundation.org)



## Why?

Geodata is expensive, difficult to order and to use  
Especially true for vector data (and orienteering map data ...)  
Object models are not standardized (ISOM is a notable exception)  
“Free” alternatives (e.g. Google Maps) are proprietary

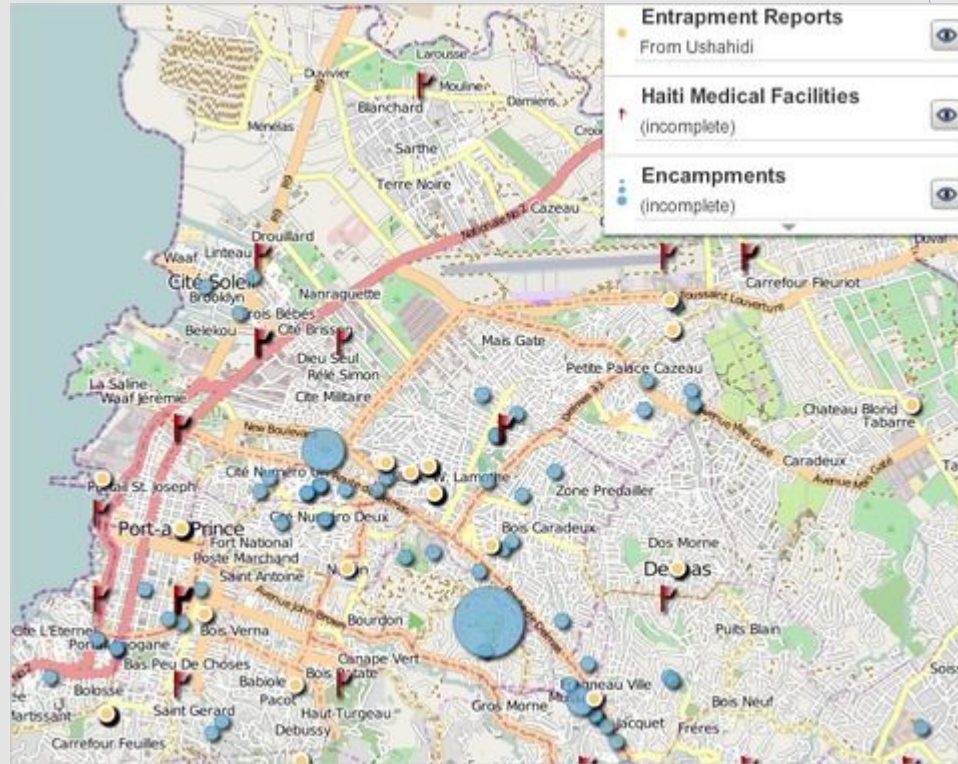
## How?

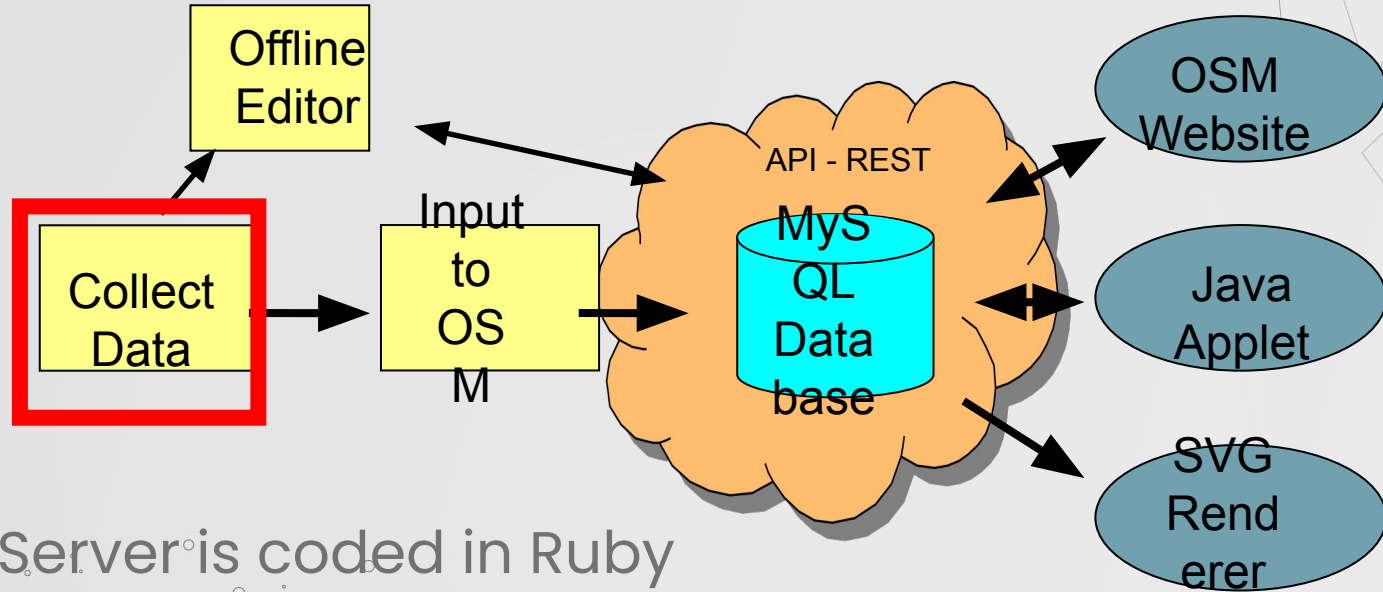
- Database – PostgreSQL (earlier MySQL)
- Editors – Potlatch (Flash), JOSM (Java), Merkaartor (Qt, i.e. C++)
  - Interactive editing (GPS tracks) and batch import
- Renderer – Mapnik (out: raster tiles) and Osmarender (out: SVG)
- Runs on Linux, Mac and Windows
- OpenSource – all software (except maybe OS)





# Digital Help for Haiti



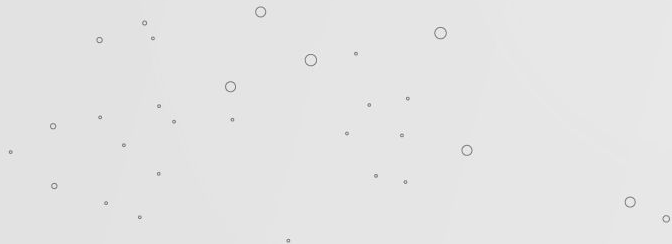


- Server is coded in Ruby
- The entire site is currently being transferred to Rails

# Getting the data – the OSM way

## Step 1 – Collect data using a GPS receiver

- We cannot use copyrighted maps to get street name information. So...





# Getting the data - the OSM way

## Step 2 - Convert to GPX format (we recommend GPSBabel)

```
<?xml version="1.0"?>
<gpx
  version="1.0"
  creator="GPSBabel - http://www.gpsbabel.org"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.topografix.com/GPX/1/0"
  xsi:schemaLocation="http://www.topografix.com/GPX/1/0 http://www.topografix.com/GPX/1/0/gpx.xsd"
  <!-- ... -->
  <trkseg>
    <trkpt lat="51.620322252" lon="0.132705353">
      <ele>13.115112</ele>
      <time>2006-08-22T11:07:29Z</time>
    </trkpt>
  </trkseg>
</gpx>
```

GPX

<trkseg>ACTIVE LOG</trkseg>

<trkpt lat="51.620322252" lon="0.132705353">  
<ele>13.115112</ele>  
<time>2006-08-22T11:07:29Z</time>  
</trkpt>  
</trkseg>  
</gpx>



## OSM XML - [http://wiki.openstreetmap.org/wiki/OSM\\_XML](http://wiki.openstreetmap.org/wiki/OSM_XML)

```
<osm version="0.6" generator="Osmosis SNAPSHOT-r26543">
  <bound box="34.01978,-117.22435,34.08958,-117.13878" origin="Osmosis SNAPSHOT-r26543"
  <node id="1487933542" version="1" timestamp="2011-10-31T22:52:01Z" uid="409545" user=""/>
-117.1977484">
```

version of the API (the features used)  
and the generator that distilled this file

```
  <tag k="name" v="180 Chiropractic"/>
  <tag k="amenity" v="doctors"/>
</node>
```

Node: location, and tags

```
...
<way id="138847897" version="1" timestamp="2011-11-29T00:20:18Z" uid="304970" user=""/>
  <nd ref="1522479496"/>
  <nd ref="1522479499"/>
  <nd ref="1522479502"/>
  <nd ref="1522479504"/>
  <nd ref="1522479496"/>
  <tag k="building" v="yes"/>
</way>
```

Way: references to its  
nodes for each way, and tags

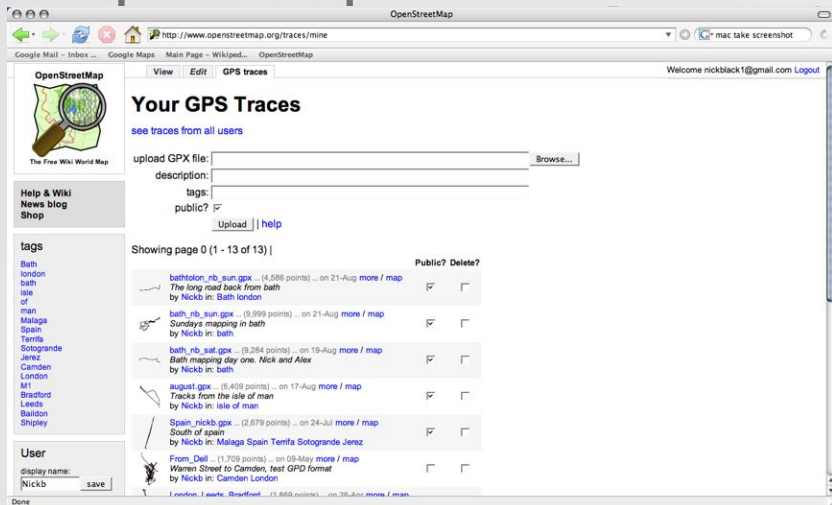
```
...
<relation id="1508496" version="2" timestamp="2012-09-11T23:31:01Z" uid="194231" user="xx" changeset="13076706">
  <member type="way" ref="172434588" role="forward"/>
  <member type="way" ref="29001116" role="forward"/>
```

Relation: references to its  
members  
for each relation, and tags

```
...
  <tag k="ref" v="10"/>
  <tag k="symbol" v="http://upload.wikimedia.org/wikipedia/commons/c/c3/I-10_%28CA%29.svg"/>
  <tag k="direction" v="west"/>
  <tag k="route" v="road"/>
  <tag k="name" v="I 10 (CA westbound)"/>
  <tag k="is_in:state" v="CA"/>
  <tag k="wikipedia" v="en:Interstate 10 in California"/>
  <tag k="type" v="route"/>
  <tag k="network" v="US:I"/>
</relation>
```

# Getting the data – the OSM way

## Step 3 – Upload to OSM



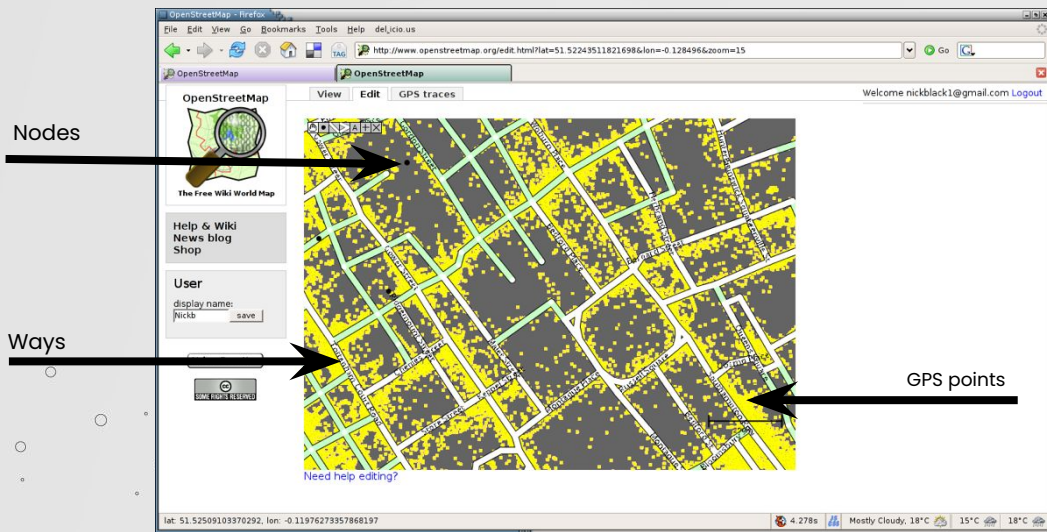
Data is instantly available via the web portal or the API



# Getting the data – the OSM way

## Step 4 – Edit the data

- Java applet allows basic editing: creating, naming and deletion of ways and segments





The OpenStreetMap feature is in beta until further notice.



Water

Earth

Buildings



Landuse

Roads

Buildings minimal height

Randomize Buildings Height

The OpenStreetMap feature is in beta until further notice.



52°22'23.4"N 4°53'26.4"E

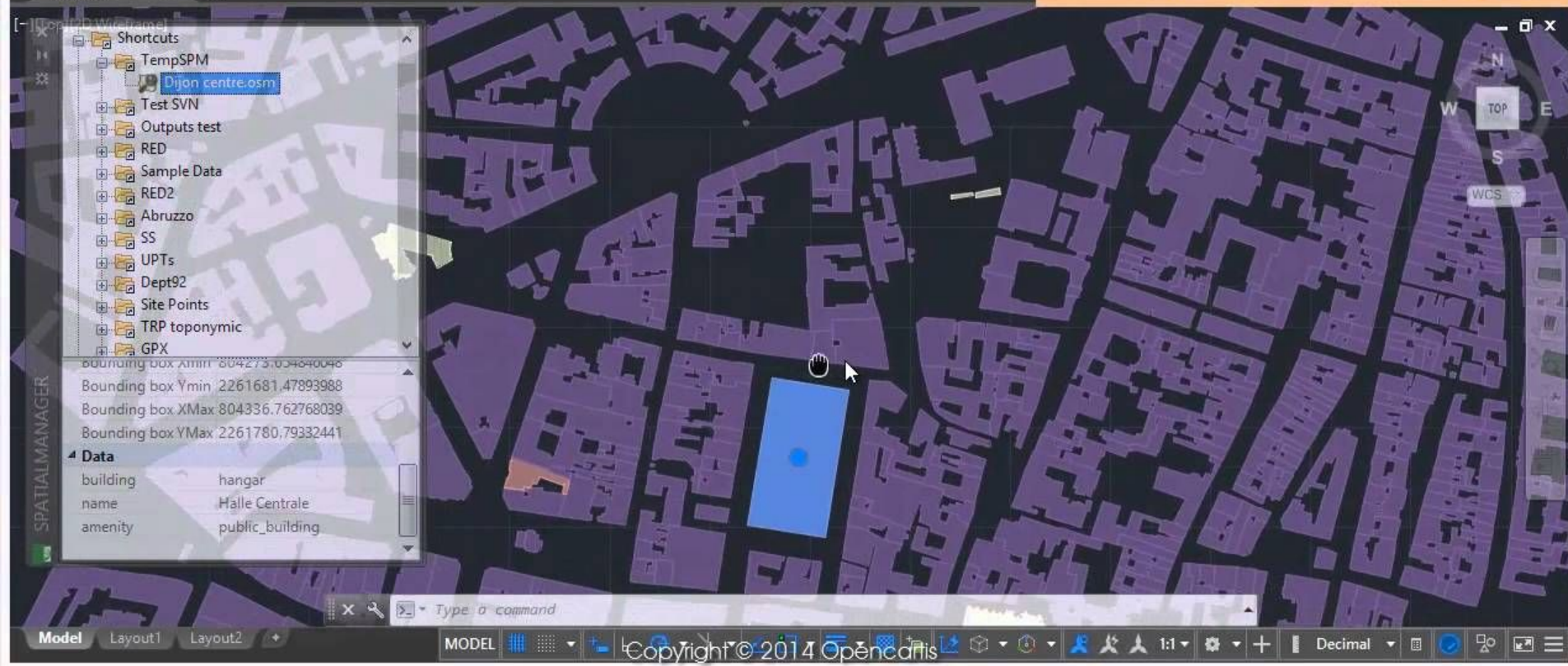
© OpenStreetMap contributors







Using the Spatial Manager™ for AutoCAD wizard you can select different subsets of the OSM file to import and different settings when importing. You can also to perform a transformation of the coordinates for the imported objects



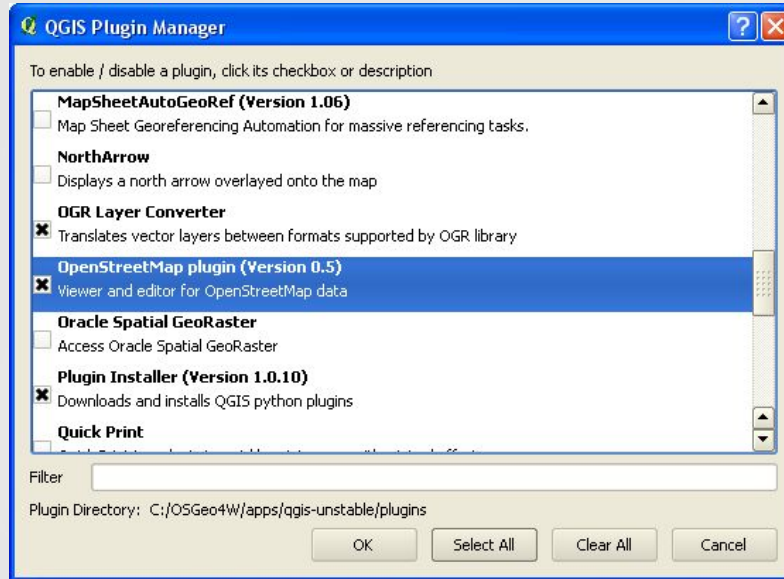




CyberCity 3D buildings in  
London compared to OSM  
models (as seen in Autodesk  
InfraWorks 360)

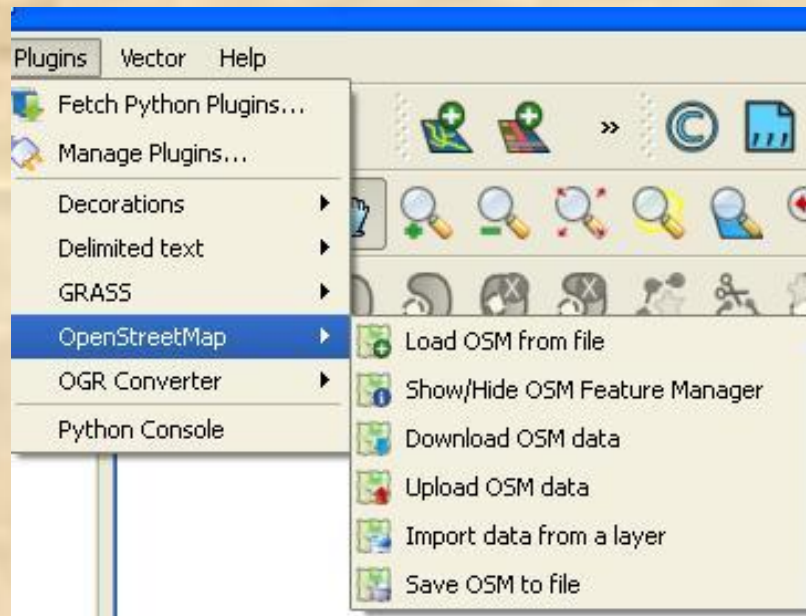
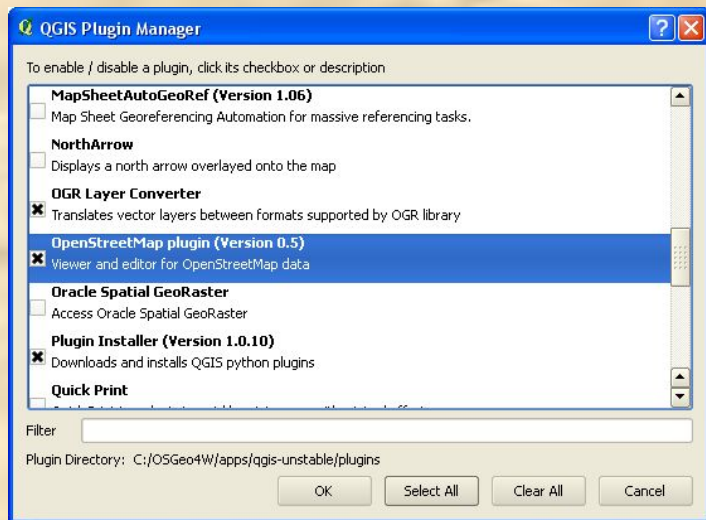


# QGIS OSM Plug In





# QGIS OSM Plug In







# QGIS Plugin

**Download OSM data**

Extent

Latitude: From  To

Longitude: From  To

**OK! Area is probably acceptable to server.**

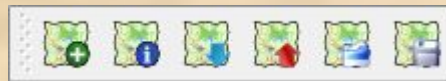
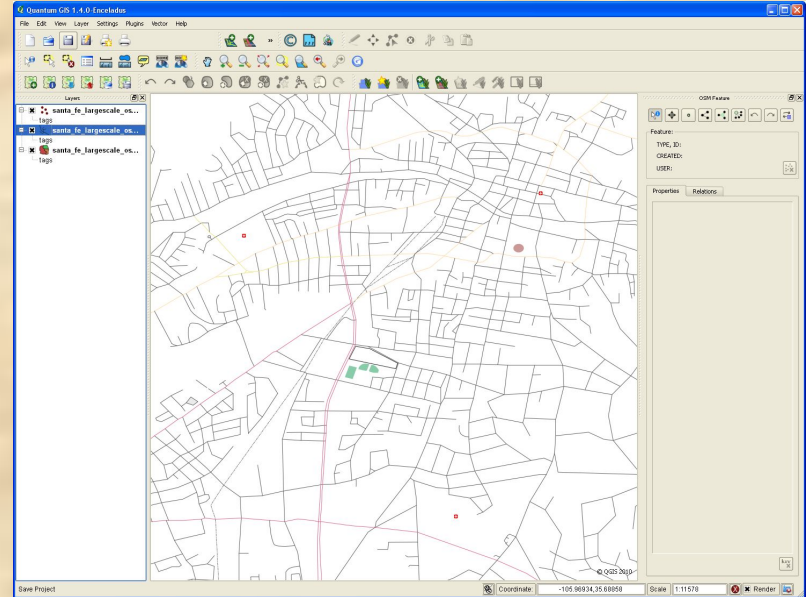
Download to:

...

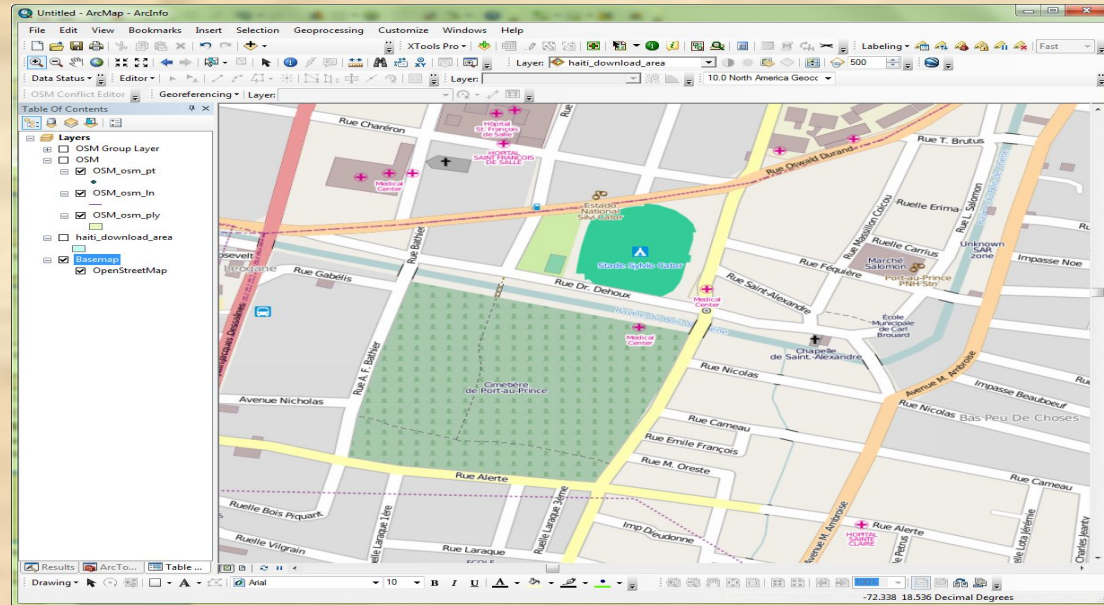
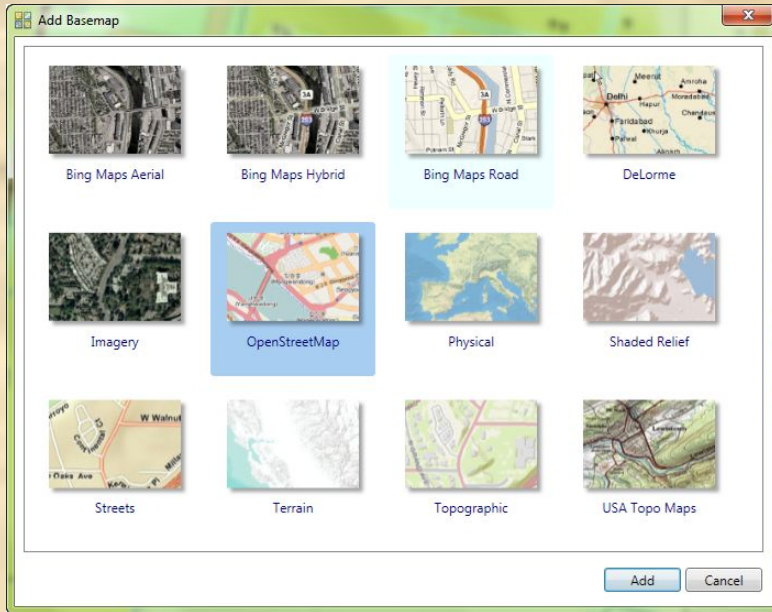
☒ Open data automatically after download

☐ Replace current data (current layer will be removed)

☒ Use custom renderer




# OSM in ArcGIS



# Editing OSM in ArcGIS







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CodePlex  
Open Source Community

Search all CodePlex projects

## ArcGIS Editor for OpenStreetMap

[Home](#) | [Downloads](#) | [Documentation](#) | [Discussions](#) | [Issue Tracker](#) | [Source Code](#) | [People](#) | [License](#) | [RSS](#) 

[View All Comments](#) | [Print View](#) | [Page Info](#) | [Change History \(all pages\)](#) |  

The ArcGIS Editor for OpenStreetMap is designed to help ArcGIS Desktop 10 users to become active members in the growing community of users building an open and freely available database of geographic data.

The provided tools allow you to download data from the OSM servers and store it locally in a geodatabase. You can then use the familiar editing environment of ArcGIS Desktop to create, modify, or delete data. Once you are done editing, you can post back the edit changes to OSM to make them available to all OSM users.


This site provides access to the released versions of the ArcGIS Editor for OpenStreetMap (OSMEditor), the source code, as well as documentation and issue tracker.


Last edited Jul 8 2010 at 7:15 PM by [mhogeweg](#), version 6

[Home](#)

### Project Description



★ [28 people](#) are following this project ([follow](#))

 **Download**


CURRENT	ArcGIS Editor for OpenStreetMap 1.1
DATE	Wed Apr 20 2011 at 1:00 AM
STATUS	Stable 
RATING	★★★★★ 1 rating 1828 downloads
MORE	<a href="#">View all downloads</a>

**Recent reviews** ([more](#))

★★★★★ arcmap Google Earth

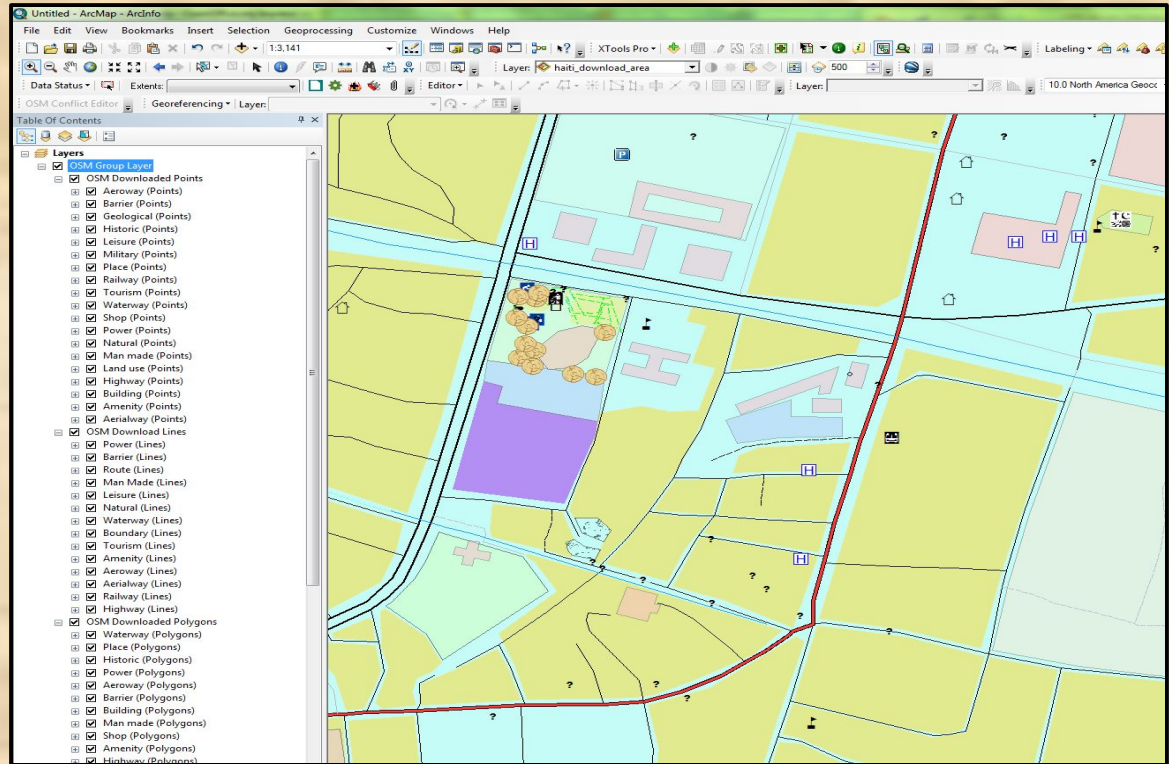
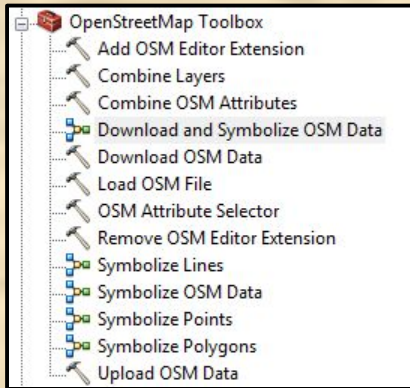
**Activity**   [All days](#)

Page Views	1227
Visits	378
Downloads	205
Application Runs	<a href="#">N/A</a>

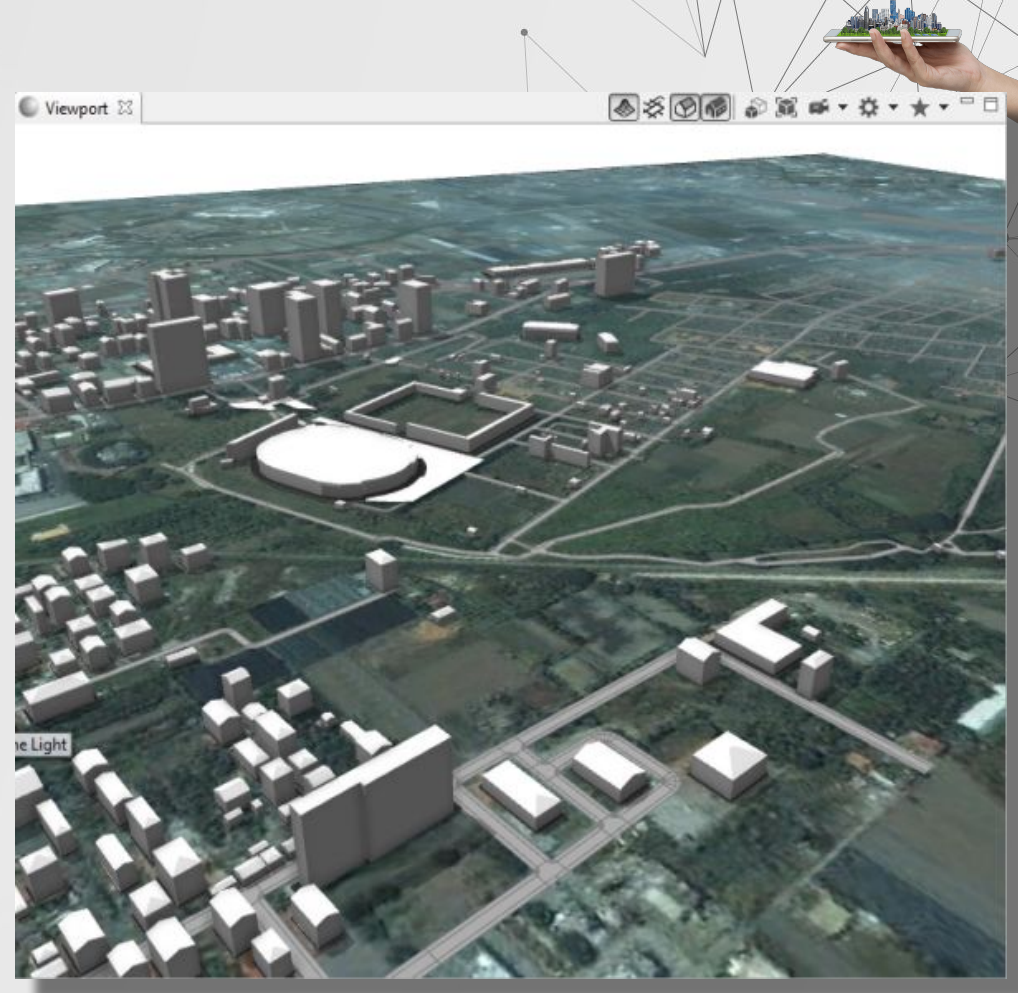
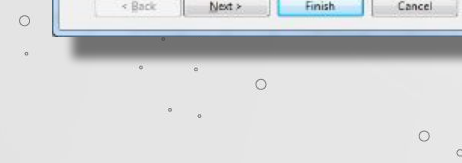
 [View Detailed Stats](#)



# Download OSM in ArcGIS



- **Produ**



# Contributions welcome

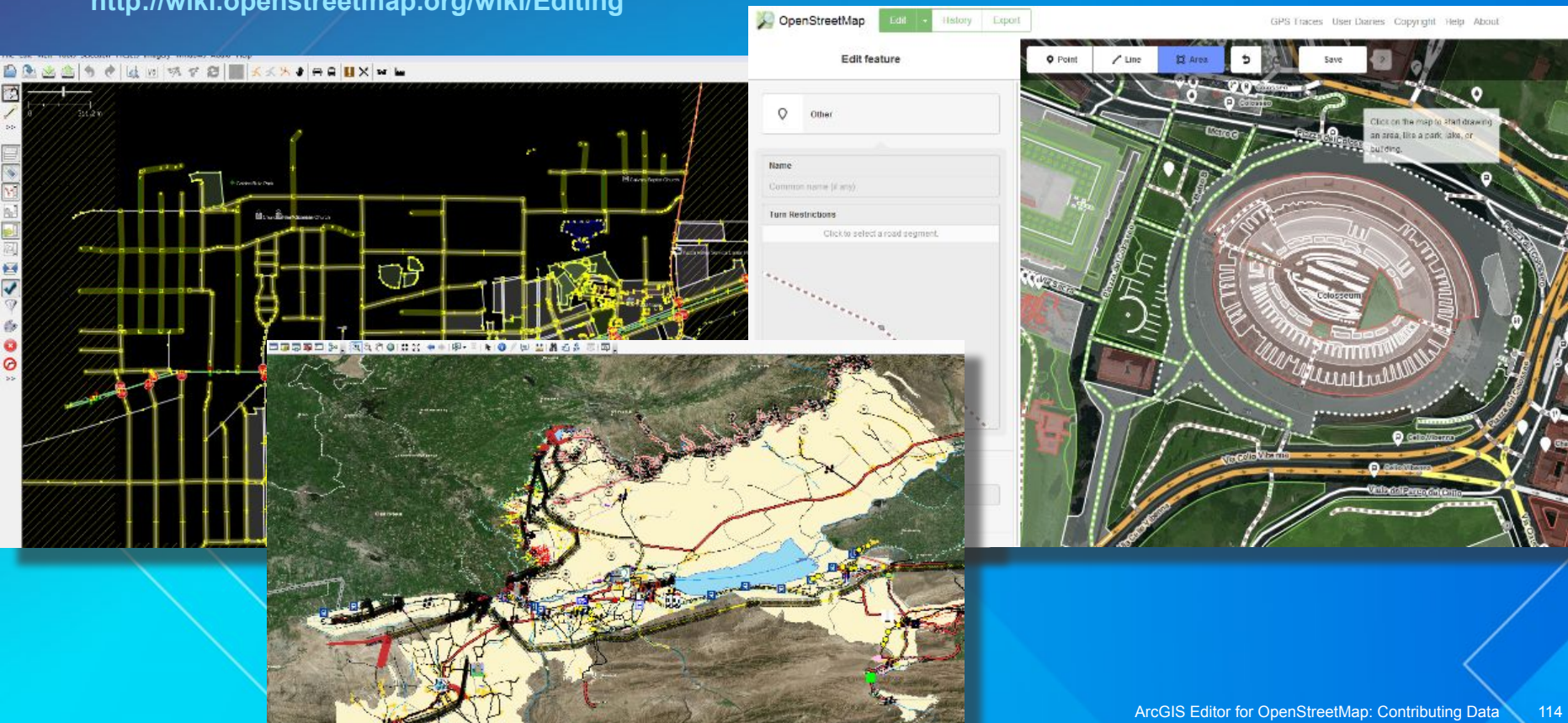
[https://wiki.openstreetmap.org/wiki/Mapping\\_projects](https://wiki.openstreetmap.org/wiki/Mapping_projects)





# Many tools to contribute data to OSM

<http://wiki.openstreetmap.org/wiki/Editing>




# ArcGIS Editor for OpenStreetMap

[Download free](#) from ArcGIS Online

## ArcGIS Editor for OSM, 10.3.x Desktop



ArcGIS for Desktop tools that support using OpenStreetMap data in ArcGIS. Load .osm files, apply symbology, contribute data back to OSM, and create network datasets from OSM data.

 Geoprocessing Sample by ceggers

Last Modified: April 3, 2015

★★★★★ (0 ratings, 3,508 downloads)

Sign in to rate this item.

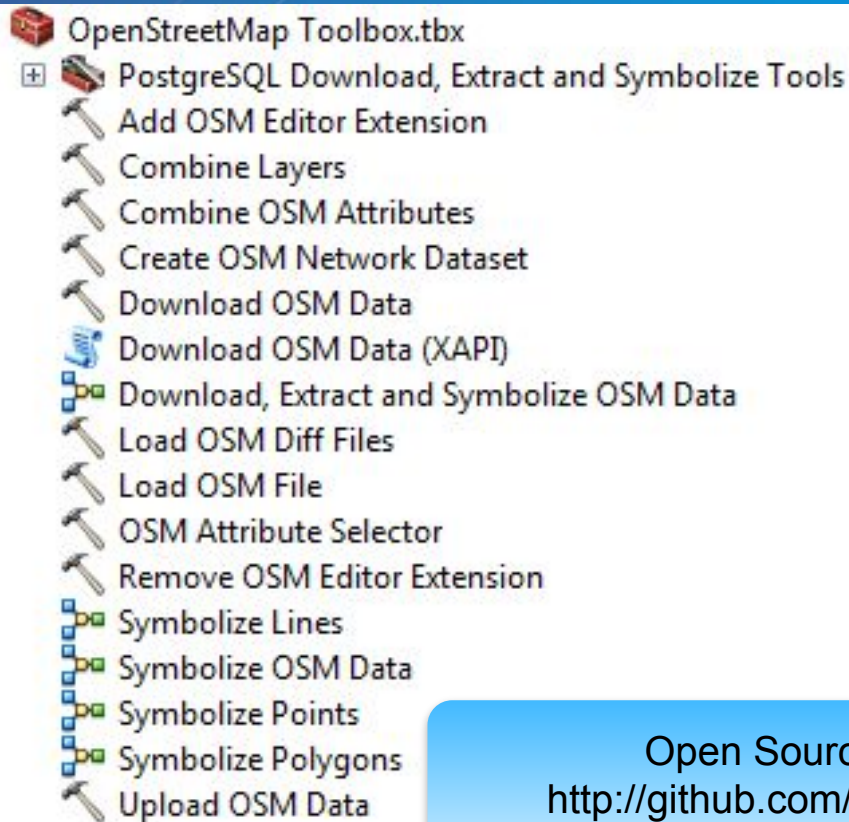
 Facebook  Twitter

OPEN ▾

- 10.3.x and 10.2.2 update:  
<https://github.com/Esri/arccgis-osm-editor/wiki/Release-Notes>



## What does ArcGIS Editor for OSM do?

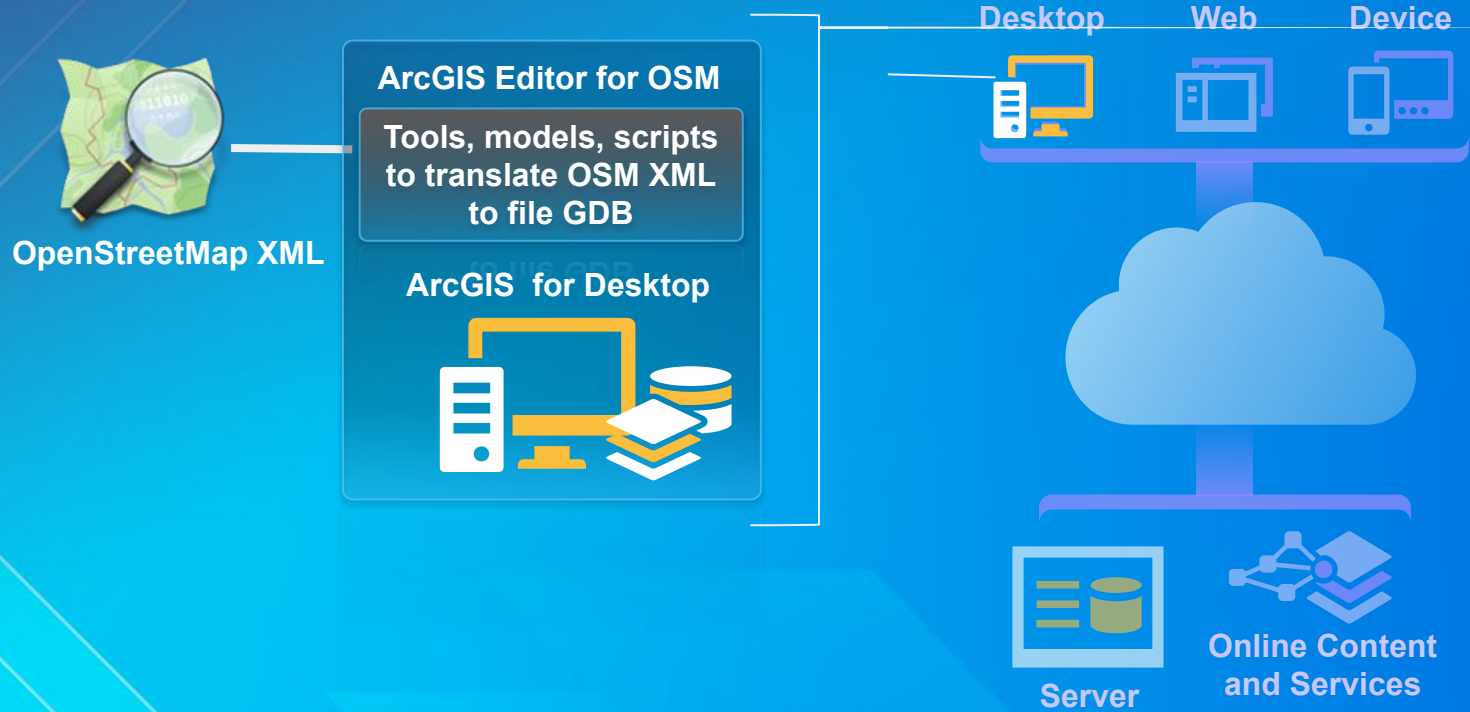


- Translate OSM data into a feature dataset you can use in ArcGIS
- Make a Network Dataset from OSM data
- Support users to contribute data to OSM through ArcMap Editing workflows

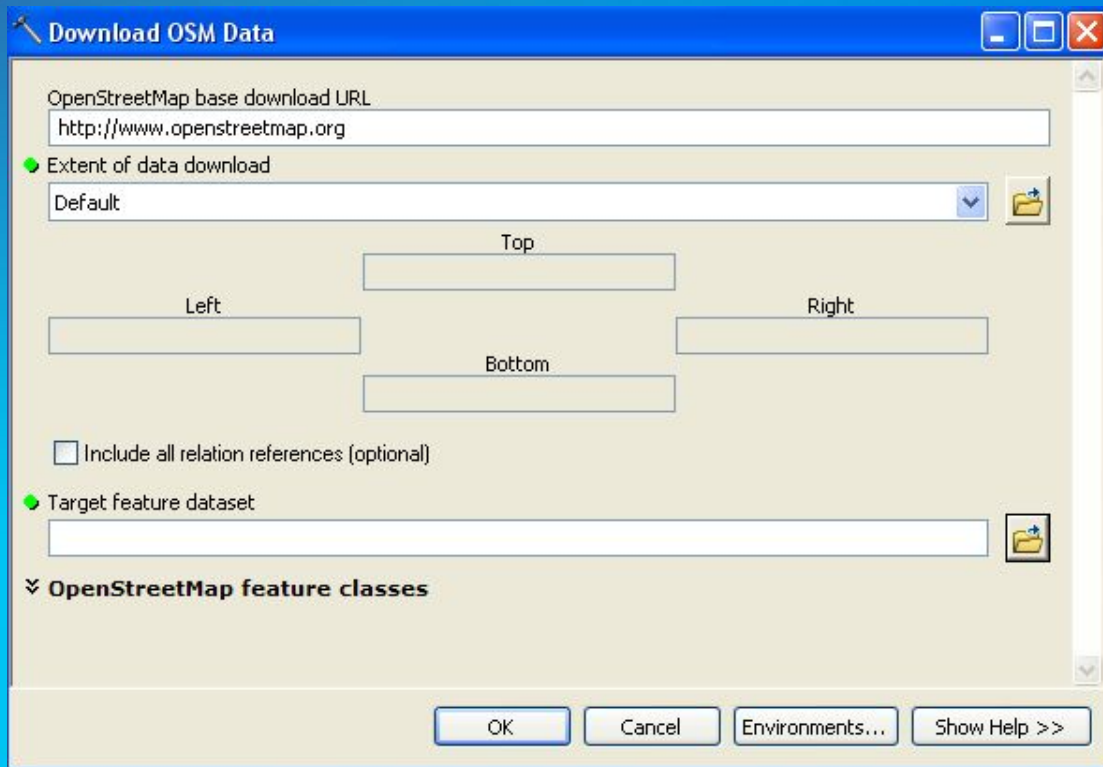
Open Source and on github:  
<http://github.com/Esri/arcgis-osm-editor>



# ArcGIS Editor for OSM Architecture



# Download OSM Data tool



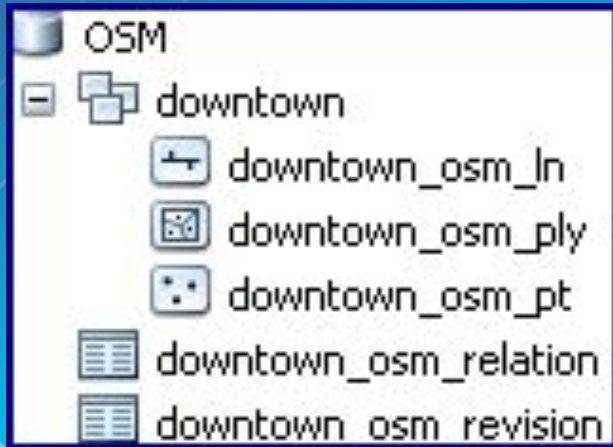
The screenshot shows the 'Download OSM Data' dialog box. It has a title bar with a hammer icon and standard window controls. The main area contains the following elements:

- OpenStreetMap base download URL:** A text box containing 'http://www.openstreetmap.org'.
- Extent of data download:** A section with a green diamond icon. It includes a dropdown menu set to 'Default' and a folder icon to its right.
- Coordinate fields:** Four text boxes labeled 'Top', 'Bottom', 'Left', and 'Right' arranged in a cross pattern.
- Include all relation references (optional):** An unchecked checkbox.
- Target feature dataset:** A text box with a folder icon to its right.
- OpenStreetMap feature classes:** A section with a collapsed arrow icon and the text 'OpenStreetMap feature classes'.

At the bottom, there are four buttons: 'OK', 'Cancel', 'Environments...', and 'Show Help >>'.



## Resulting feature classes and tables



- **osm\_relation**

- Maintains relations between features as described in OSM as the user works with the OSM data in ArcGIS
- E.g., primary, secondary, and residential types of road line features may have a relation to describe how these define a bus route

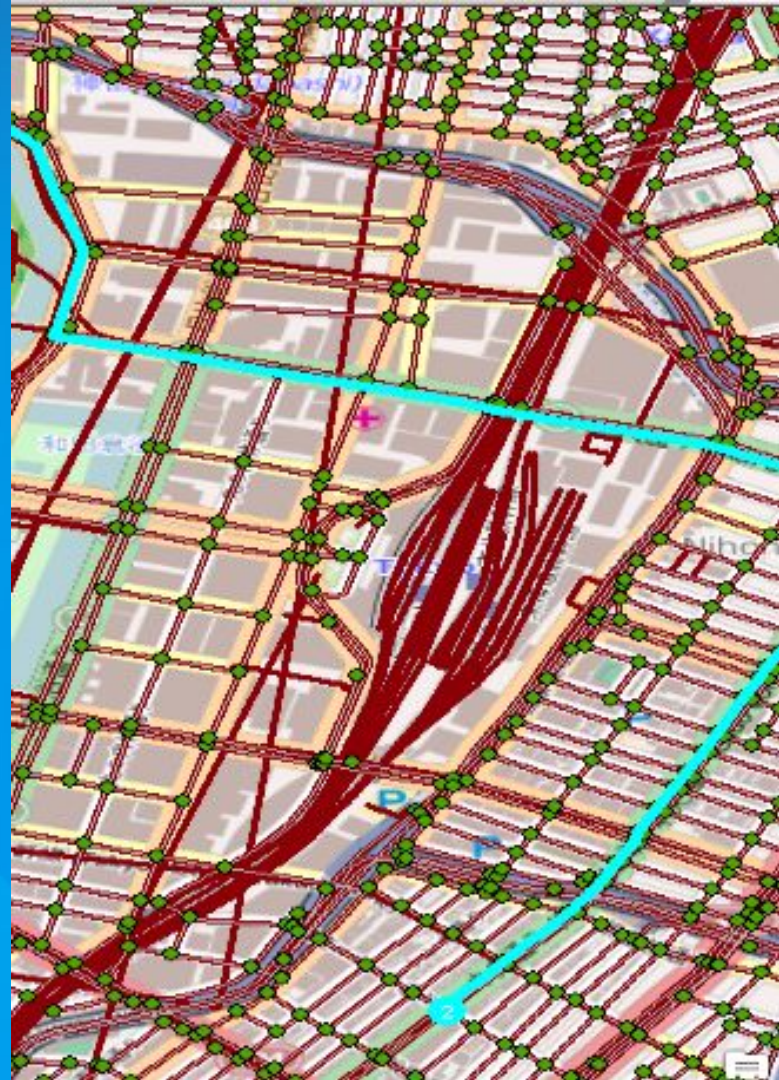
- **osm\_revision**

- Track edits to the downloaded OSM dataset that are made by you as you edit it
- Used if you choose to upload data back to OSM



## Editing using the ArcGIS OSM Editor

Demo



# Contributing an existing dataset to OSM through ArcGIS



freq	var	vis	grid	fill
74.67	0.001	1.000	1.000	1.000
/sec	/sec	ratio	ratio	ratio

# Lots of creative tools and products out there





# Want to find out more?

- [www.openstreetmap.org](http://www.openstreetmap.org)
- [www.opengeodata.org](http://www.opengeodata.org)
- OpenGeoData <http://opengeodata.org/>
- OSM Streetview
- Open Aerial Map
- Free Earth Foundation
- NASA World Wind
- <http://www.freeearthfoundation.com/> (NASA World Wind)
- Open knowledge Foundation <http://www.okfn.org/>
- The Map <http://www.openstreetmap.org/>
- Wiki [http://wiki.openstreetmap.org/wiki/Main\\_Page](http://wiki.openstreetmap.org/wiki/Main_Page)
- Planet OSM <http://wiki.openstreetmap.org/wiki/Planet.osm>
- Twitter [@openstreetmap](https://twitter.com/openstreetmap)
- QGIS
- [http://www.qgis.org/wiki/Using\\_OpenStreetMap\\_data](http://www.qgis.org/wiki/Using_OpenStreetMap_data)
- OSM → PostGIS



# BIM workflow

- BIM enable **Everyone** - access - **All Project Data** at **Anytime**

(**Common Data Environment**)

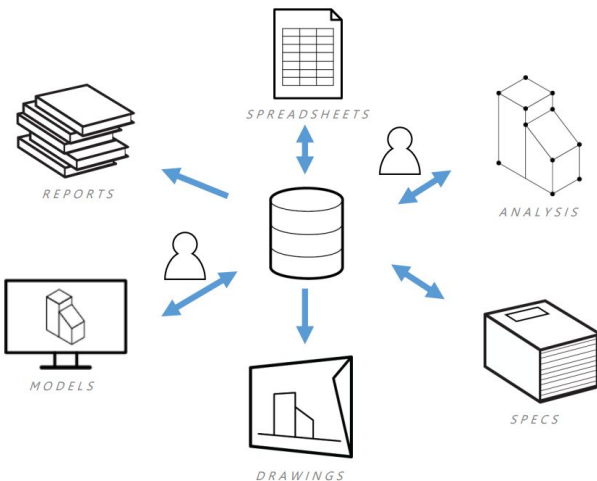
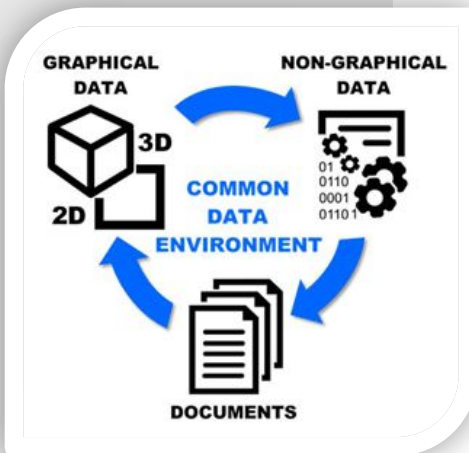
(BIM platform)

Cloud-based.

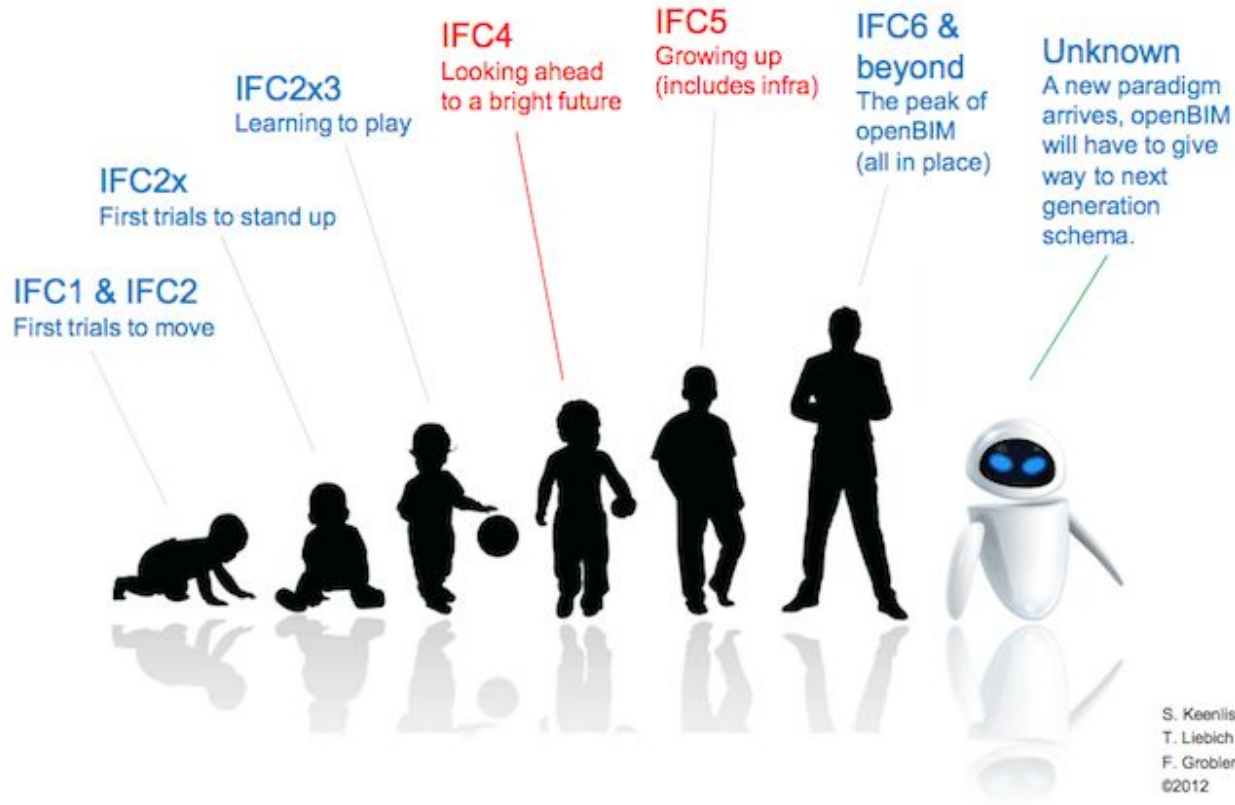
Manage user access.

Host different file formats.

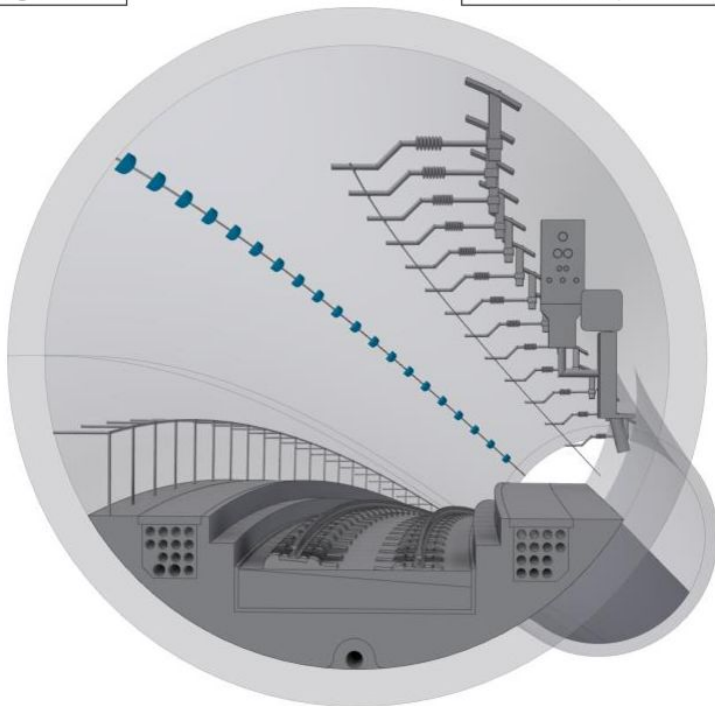
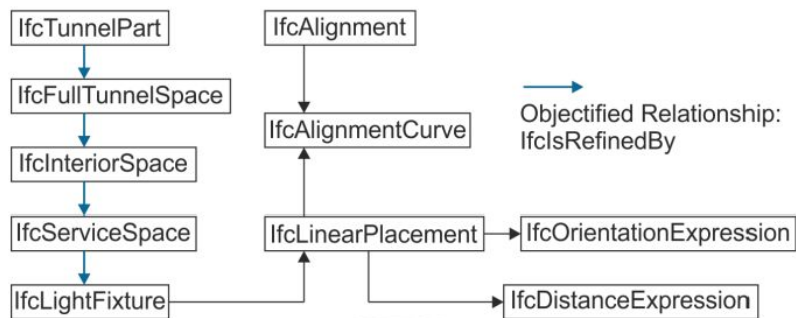
Integrate a 3D BIM model viewer.



**BIM is about sharing information and working together**







LoD 2

FullTunnelSpace

TunnelAxis

LoD 3

AnnularGapSpace

LiningSpace

InteriorSpace

LoD 4

ClearanceSpace

ServiceSpace

TrackSpace

FloorSpace

LoD 5

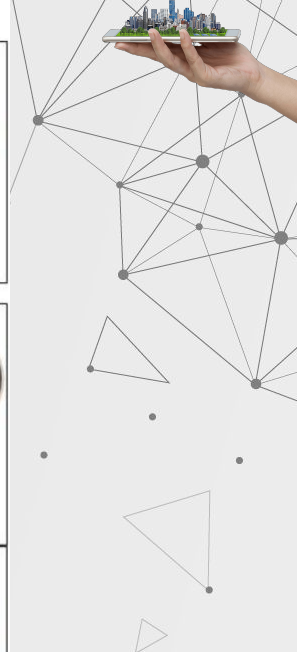
Ring Segment

Traffic Light

Walkway

Cable Duct

Track Bed Concrete



# 3 Stages of 3D Digital Map Development

## Stage 1

- 3D maps for visualization



## Stage 2

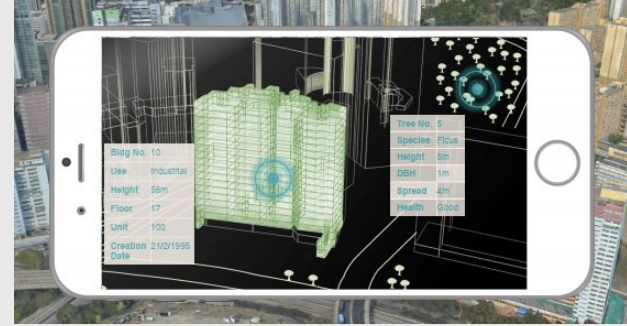
- 3D maps for floor/unit-based indoor applications



Build No.	10
Use	Industrial
Height	56m
Floor	17
Unit	100
Creation Date	21/02/1995


## Stage 3

- 3D maps for city modelling

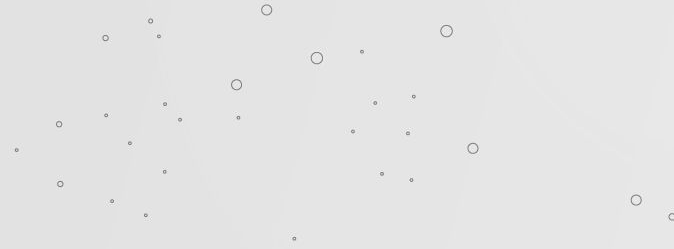


## Stage 1





With a *BIM for Sustainable Cities* plan, municipalities are better able to:

- Coordinate with architects, engineers, contractors and others
  - Better share digital design information, geospatial data, infrastructure models and other documentation among staff and project stakeholders
  - Use that information to accurately predict performance, appearance and cost
  - Reliably deliver municipal projects faster, more economically and with reduced environmental impact
  - Leverage model-based design information for operation and maintenance
- 



## LiDAR/Laser Scan to BIM



- Creating of 3D BIM models with point cloud data generated from laser scanning
- Production of as-built CAD drawings from the generated models
- Beneficial for Renovation, Refurbishment / Retrofitting of existing structures



### Smart Energy: Digital Management of Energy



- Smart grids
- Smart meters
- Intelligent energy storage

### Smart Buildings: Automated Intelligent Buildings



- Building Automation
- Intelligent Buildings: Advanced HVAC, Lighting Equipment

### Smart Mobility: Intelligent Mobility



- Advanced traffic management system (ATMS)
- Parking management
- ITS-enabled transportation pricing system

### Smart Technology\*: Seamless Connectivity



- 4G connectivity
- Super broadband
- Free Wi-Fi
- 1Gbps download speeds

### Smart Infrastructure: Digital Management of Infrastructure



- Sensor networks
- Digital water and waste management

### Smart Governance and Smart Education: Government-on-the-Go



- eGovernment
- eEducation
- Disaster management solutions

### Smart Healthcare: Intelligent Healthcare Technology



- Use of eHealth and mHealth systems
- Intelligent and connected medical devices

### Smart Citizen\*: Civic Digital Natives



- Use of green mobility options
- Smart lifestyle choices

### Smart Security: Next Generation 911



- Surveillance
- Biometrics
- Simulation modeling and crime protection
- C2 and response

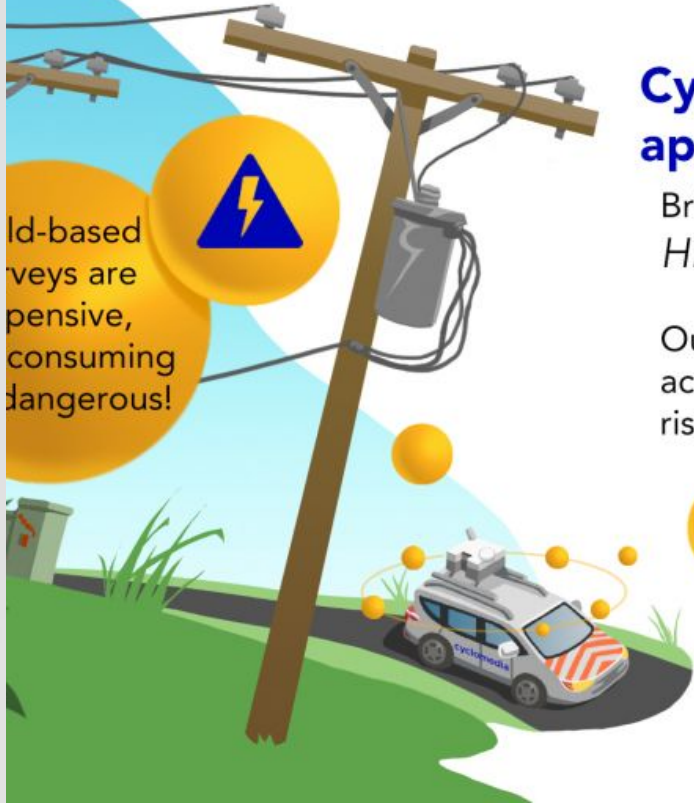
\*Smart citizen and smart technology are integrated and not covered separately in this analysis.

Source: Frost & Sullivan



# The cyclomedia Solution Difference

VISUALIZE A BETTER WORLD



Field-based surveys are expensive, consuming dangerous!

## Cyclomedia brings a modern approach to asset management

Bring the real world to your desktop with *HD 360° Imagery and LiDAR*.

Our solution creates a high quality, accurate asset database while lowering risk with fewer resources.



Cut your project timelines and costs in

**HALF**

compared to traditional methods.



Accelerate asset inventory with precise data for vegetation mapping, reliability, and

INTEGRATE WITH  
Esri  
Smallworld  
AutoCAD



Unpack Data

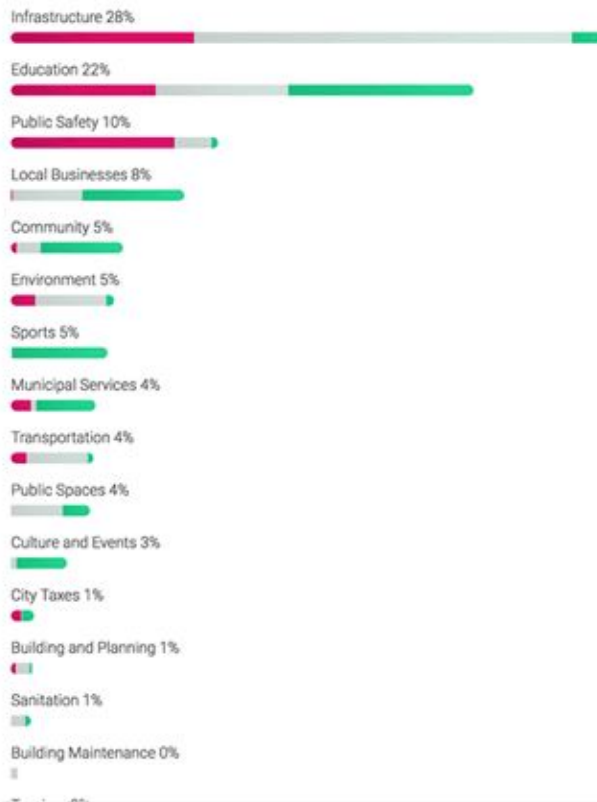
Gain insights from attachments & data



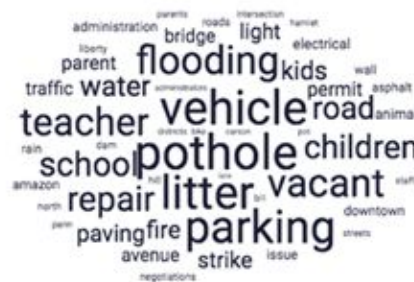




## TRENDING TOPICS



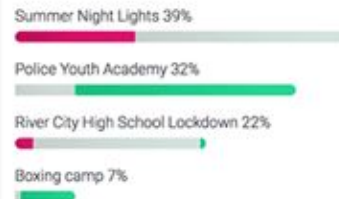
## POPULAR WORDS



## SENTIMENT OVERVIEW



## PROJECTS



## LEADING STORIES

📅 4/16 11:23 am

Transportation Public Transportation

The voters of West Sacramento voted overwhelmingly to fund a new streetcar line linking our downtown (civic center/library/college/senior center/theater/community center & central business district), Raley Field, the Washington neighborhood, the Bridge District, and the riverfront with Old Sacramento, the rail station, the Golden 1 Center, downtown Sacramento, and Midtown. From that initial investment, we've leveraged \$170 million in funds.

👍 137 🗨️ 13 🔗 7

## MAP

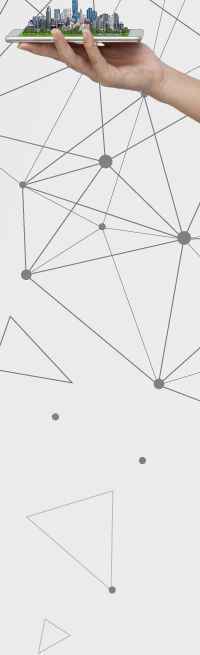
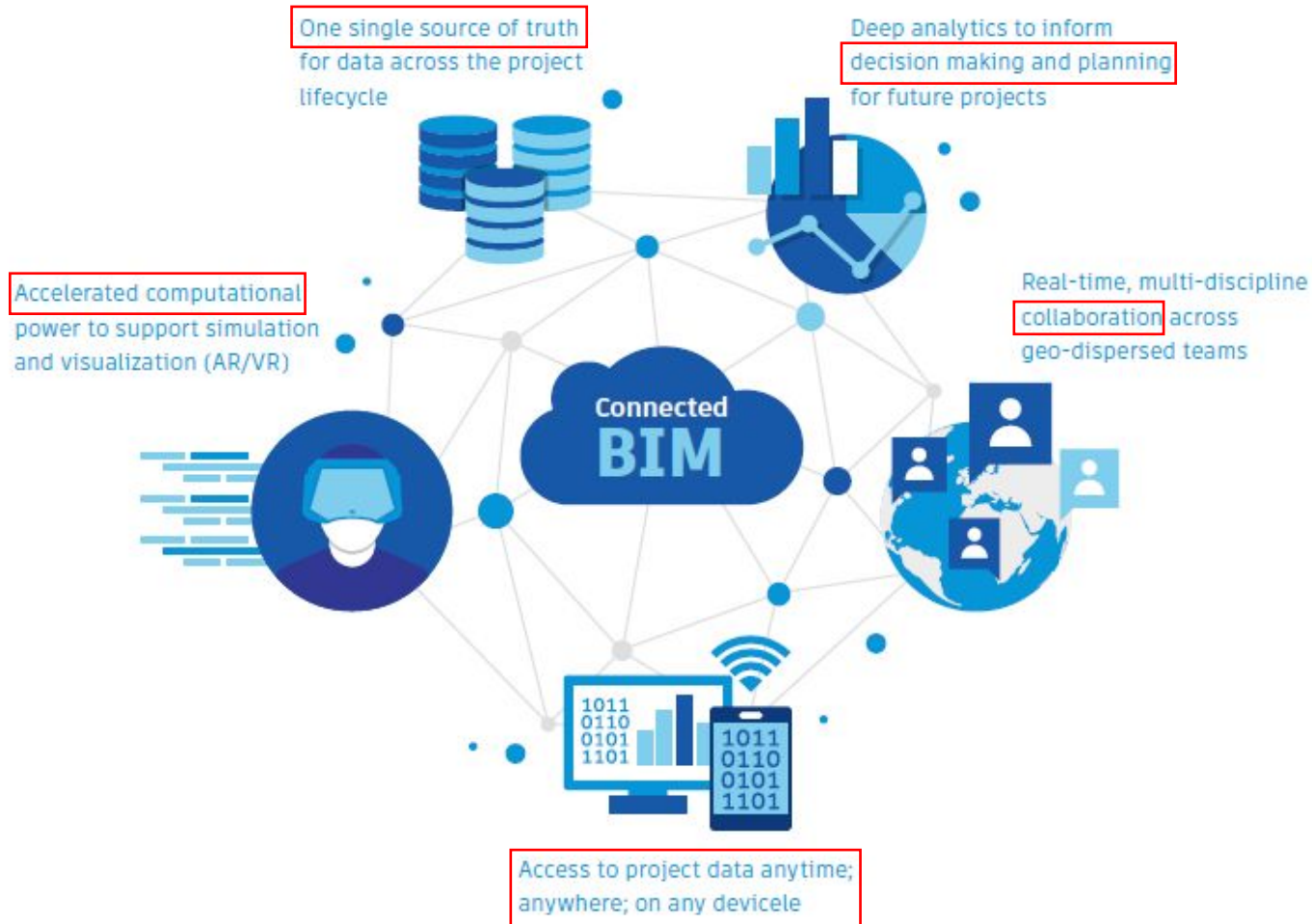
Leading Topics

📍 by Topic

📍 by Type

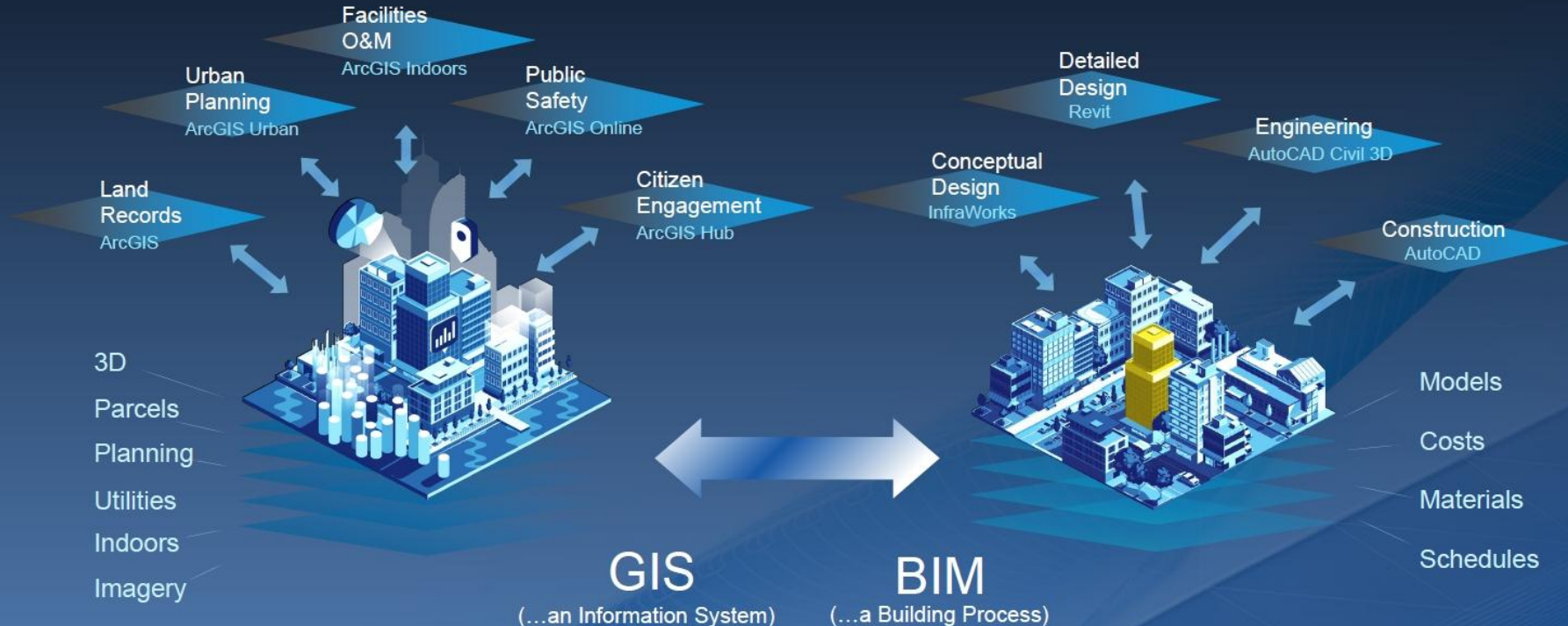
Heat map



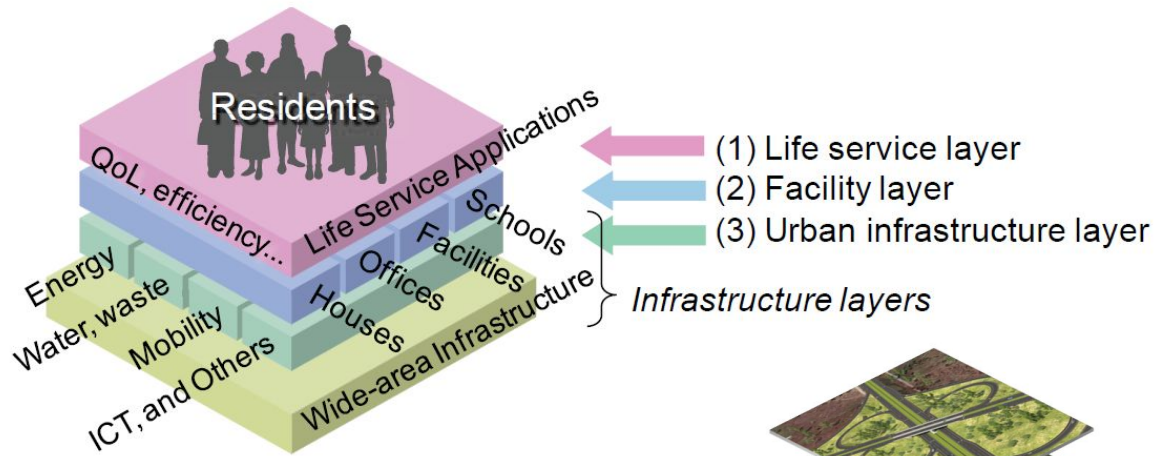


# Smart Cities and Infrastructure with GIS and BIM

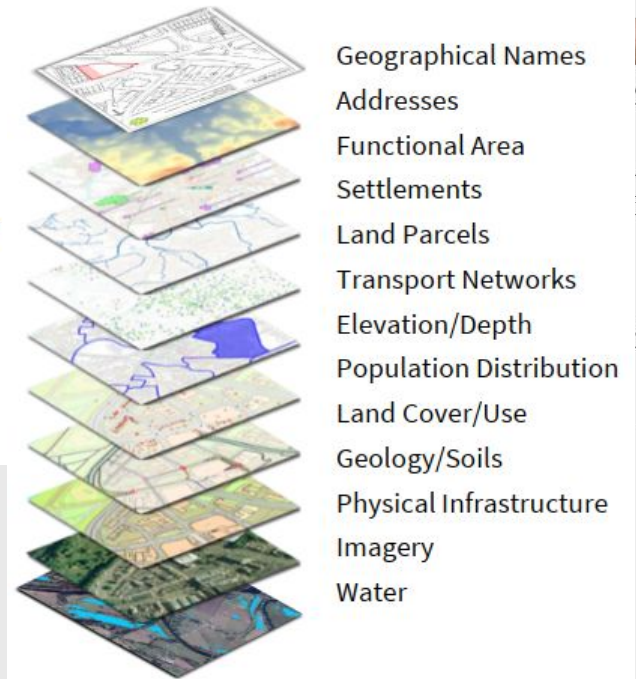
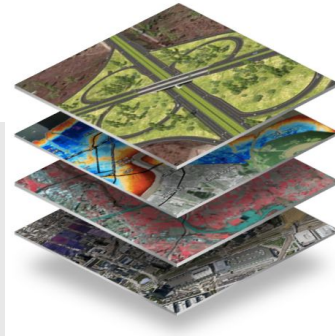
Technology integration leads to smarter more efficient cities







## Three layer model of city functions



Citizen engagement

Issue identification and  
prioritisation



Data collection

Right data, at the right  
time



Technology

Identifying the  
right technology  
to do the job



Optimum solutions and value

# The smart city framework

## A. Guiding principles

Visionary

Citizen-centric

Digital

Open and collaborative

## B. Key cross-city governance and delivery processes

### Business management

[B1] City vision

[B2] Transforming the city's operating model

[B3] Leadership and governance

[B4] Stakeholder collaboration

[B5] Procurement and supplier management

[B6] Mapping the city's interoperability needs

[B7] Common terminology and reference model

[B8] Smart city roadmap

[B9] Empowering stakeholder-led service transformation

[B10] Delivering city-led transformation

Citizens

Businesses

[B11] Identity and privacy management

[B12] Digital inclusion and channel management

Technology and digital asset management

[B13] Resources mapping and management

[B14] Open service-oriented, city-wide IT architecture

## D. Critical success factors

Strategic clarity

Leadership

Skills

Stakeholder engagement

User focus

Supplier partnership

Achievable delivery

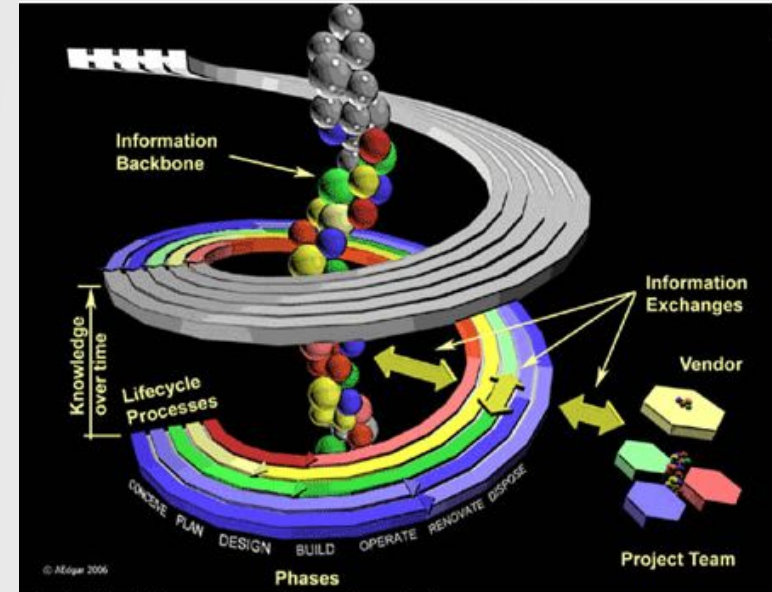
Future proofing

Benefit realization

C. Benefit realization strategy

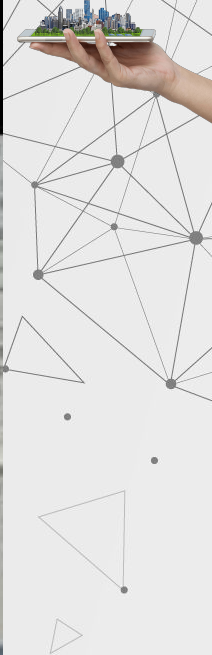
# BIM and Urban Planning and Design

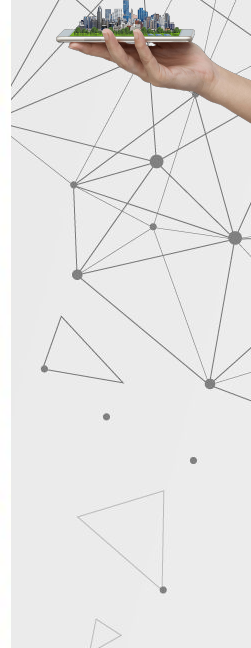
Omar Selim



A helical building process lifecycle model

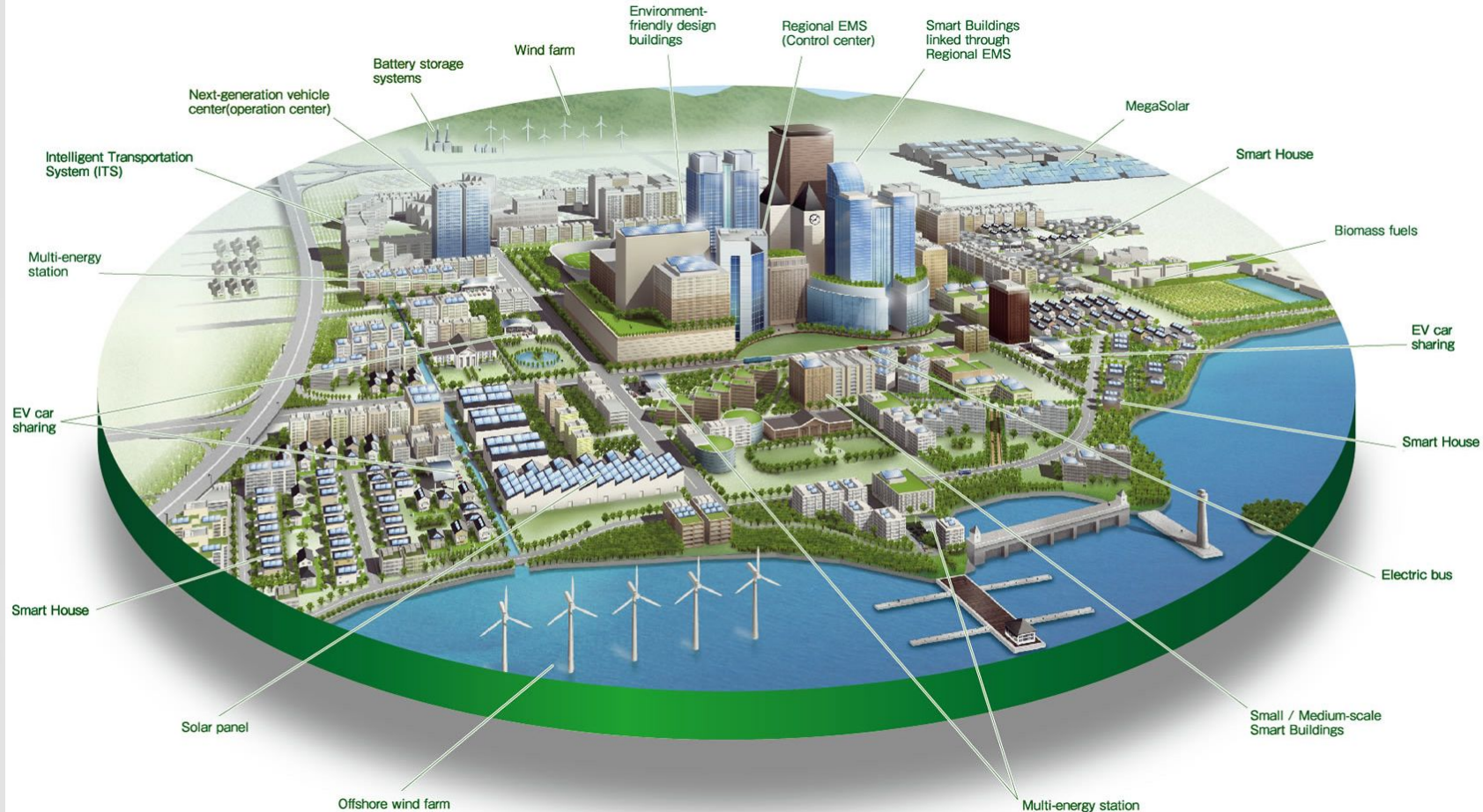






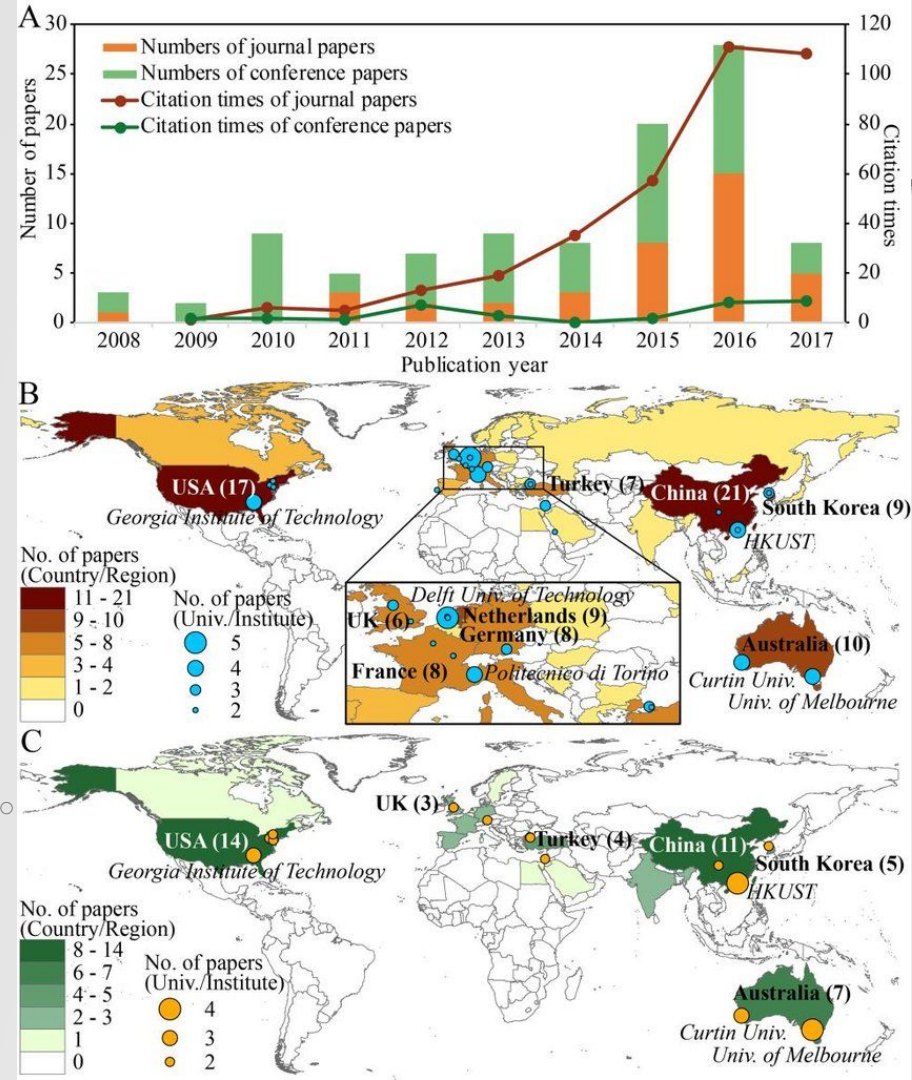


# International and regional experiences in





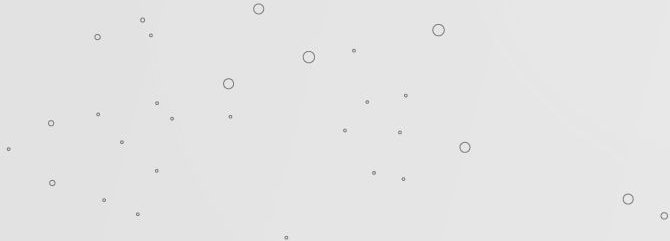
Trends and worldwide distributions of BIM-GIS integration during the past ten years. (A) 149 Trends of publications; (B) Map of publications; and (C) Map of SCI/SSCI indexed journal papers.



A *BIM for Sustainable Cities* plan is part of a [3D digital cities](#) initiative and depends on the convergence of CAD, GIS and BIM and the integration of...



- Modeling and Design
- Surveying & Data Collection
- Planning, Site Selection & Conceptual Design
- Clash Detection, Simulation and Analysis
- Visualization
- Multidiscipline Coordination
- Construction & Construction Management
- Operation and Maintenance



# Why use BIM?

- 3D digital representations of infrastructure
- Includes descriptive info (dimensions, materials, manufacturers, etc.)
- Aids in proper design, construction, operation, and maintenance
- Drawback: files size and complexity make data difficult to repurpose



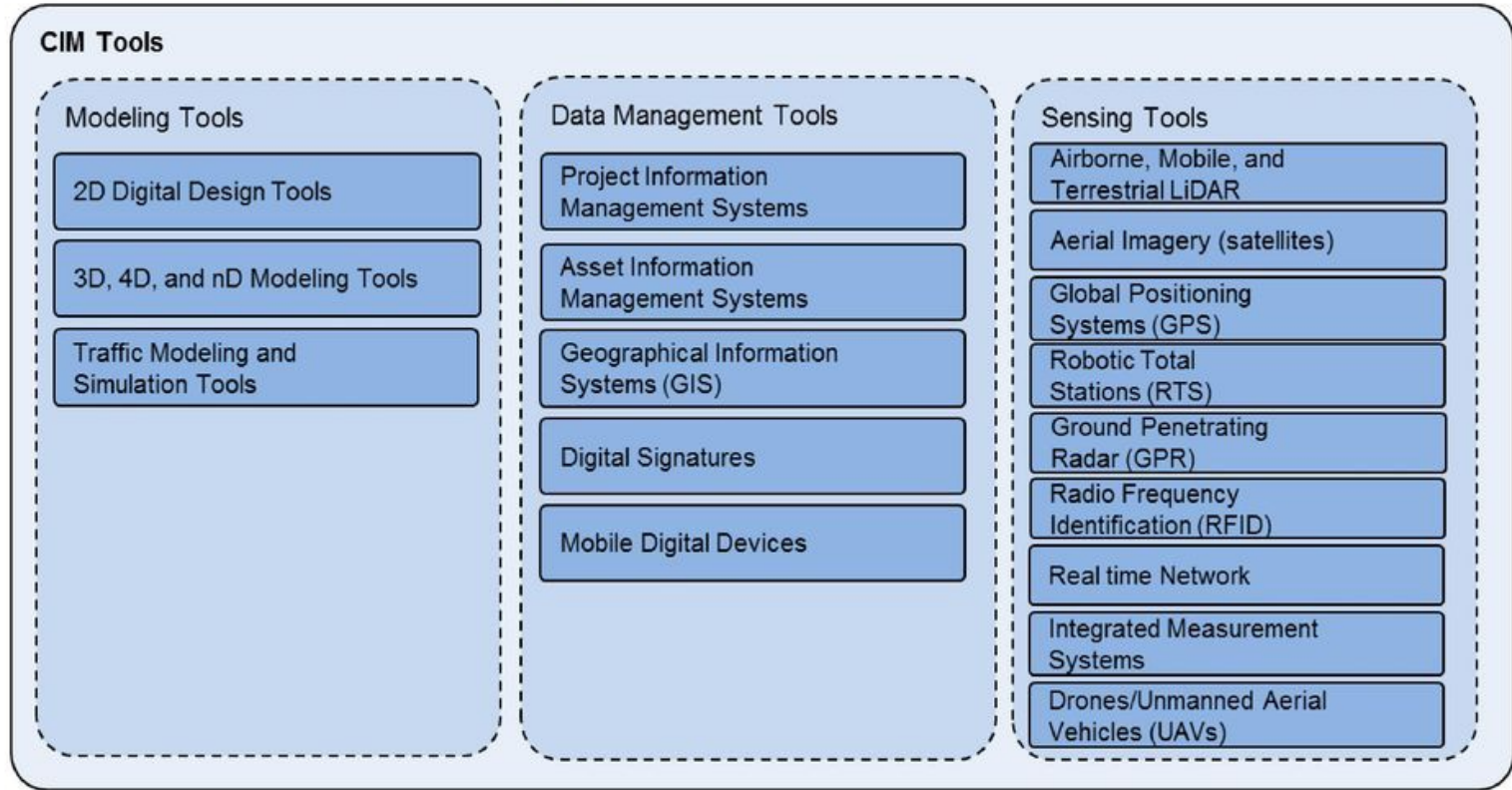


# Why use GIS?

- Map and analyze geographic features
- Uses location and imagery
- Conveys data on a large scale
- Data models, attributes, simple geometries, and domains



# CIM Utilizes Many Tools



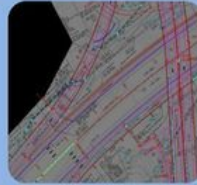
CIM core blocks



CIM Tool

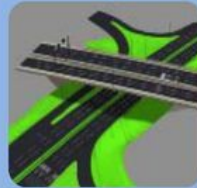
# CIM Tools – Modeling

- Create virtual/digital representations of project data



## 2D Digital Design Tools

- Tools that agencies use for design data exchange and organization
- Some examples include plans, specifications, and 2D CAD files



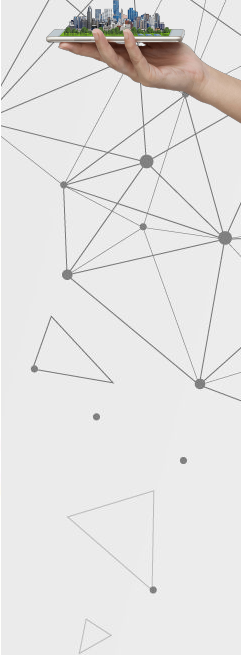
## 3D, 4D, and nD Modeling Tools

- Tools to create 3D/4D/5D models for design and visualization.
- Resolving spatial conflicts among design entities (e.g. utility conflicts) and construction activities (temporal conflicts)



## Traffic Modeling and Simulation Tools

- Tools used to conduct studies through simulation at macroscopic (state or regional ) or microscopic (roadway) level
- Used for Impact studies (e.g. traffic delays) and aids public information when combined with design visualization





# CIM Tools – Data Management

- Software to manage project information throughout design, construction, and maintenance lifecycle



## Project Information Management Systems

- Manages & allows sharing of documents, databases, model-based data during project delivery processes
- Includes document management systems for contract administration, daily work monitoring, and overall project management



## Asset Information Management Systems

- Used for archiving asset data after construction and supports inventory asset management during O&M lifecycle
- Also assists future project development.



## Geographical Information Systems (GIS)

- Associates databases with geospatial positioning information
- Offers benefits for planning and programming, environmental assessment, surveying, and asset management



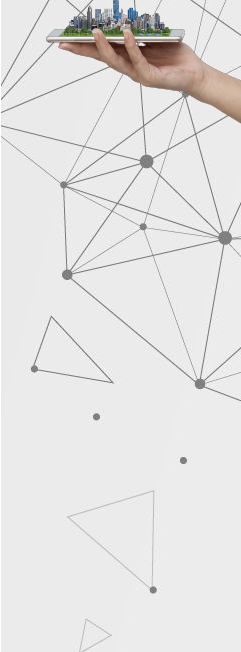
## Digital Signatures

- Electronic signatures secured with encryption technology
- Eliminates need to print, sign, and scan and allow continuous flow of digital documents



## Mobile Digital Devices

- Allows field access of digital documents
- Eliminates need to carry all the paper copies of plans, Specifications, Standards required for inspectors of multiple projects



# CIM Tools – Sensing

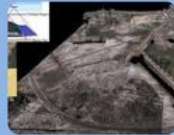
- Advanced Surveying tools improve coverage, speed, data accuracy, and can reduce costs.



## Airborne, Mobile, and Terrestrial LiDAR

Laser scanning and measurement in three different configurations (static, mobile and airborne)

Uses: Accurate and dense point cloud data for design, quantity estimates, and 3D Models



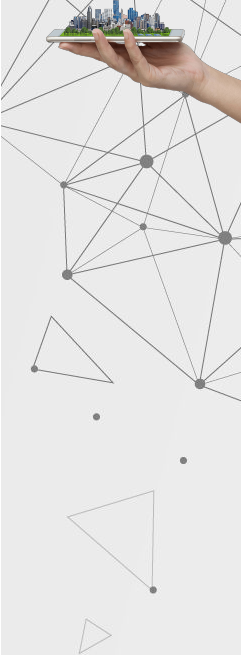
## Aerial Imagery

- Overlaps two grayscale photos taken from aircraft to provide 3D data
- Design and computation of earthwork, mapping, photogrammetry



## Global Positioning System (GPS)

- 3D spatial coordinate data used for design & construction
- Mapping, surveying, Automated Machine Guidance.



# CIM Tools – Sensing (cont'd.)



## **Robotic Total Stations (RTS)**

- Remote-controllable Total Stations from observation point (one-operator)
- Greater accuracy of measurements, used for AMG (final earthwork, paving, etc.)



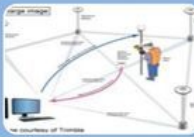
## **Ground Penetrating Radar (GPR)**

- Subsurface mapping using radio waves.
- Locate underground utilities, groundwater, tunnels, and other objects



## **Radio Frequency Identification (RFID)**

- Tags/chips emit radio waves for tracking
- Track materials, equipment, utilities, etc.



## **Real Time Network (RTN)**

- Continually Operating Reference Stations (CORS) for real-time positioning
- Surveying, AMG, QA/QC checks



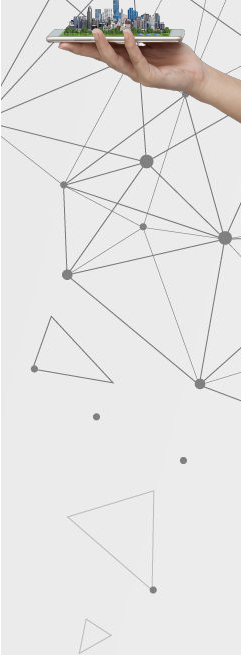
## **Integrated Measurement System (IMS)**

- Feedback control system with sensors and GPS for temperature control
- Used for Intelligent Compaction (IC)



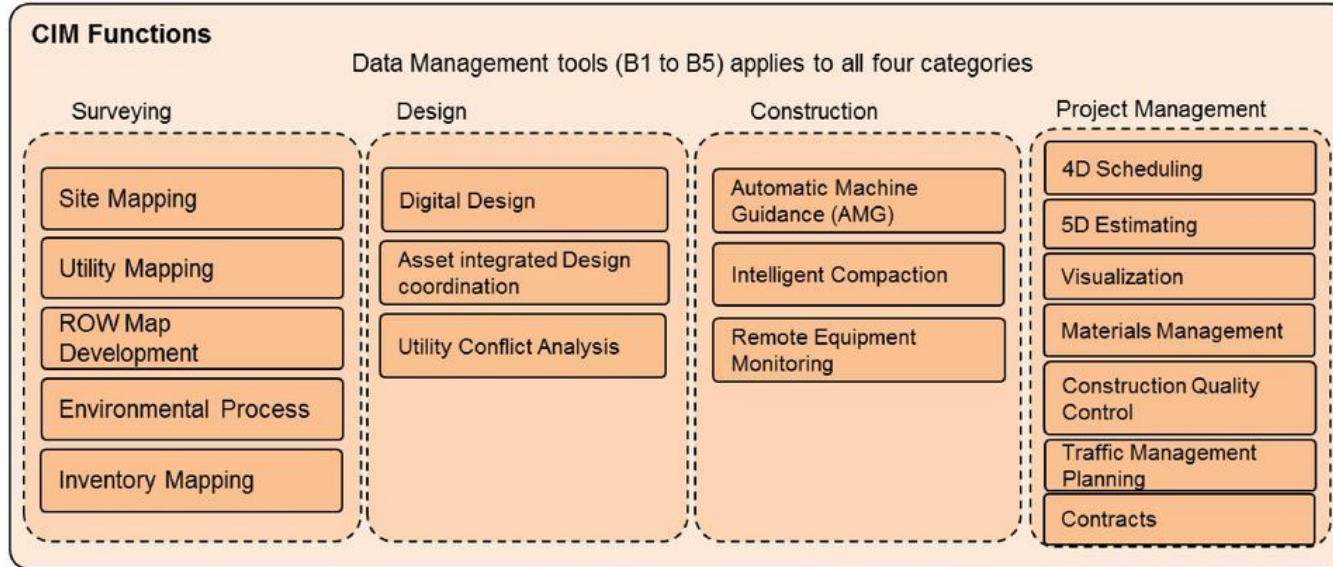
## **Unmanned Aerial Vehicles (UAVs)**

- Drones collect geo-referenced images and point clouds for surveying and quality control
- Rapid data collection, high precision, image resolution





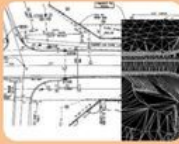
# CIM Tools Affect Many Functions



Each CIM tool improves the performance, predictability or transparency in executing one or more CIM functions.

# CIM Functions – Surveying

- CIM functions primarily related to *data collection and measurement* tasks for project development and asset management



## Site Mapping

- Advanced surveying tools (LiDAR, drones, RTN for geospatial data collection)
- Expedite project development, tracking work progress, creating as-built records



## Utility Mapping

- Utilizing tools such as RFID, GPR, and GPS to locate and store utilities data
- Resolve utility conflicts preconstruction and utility coordination process



## ROW Map Development

- GIS and asset information systems to digitally record and manage files and plans



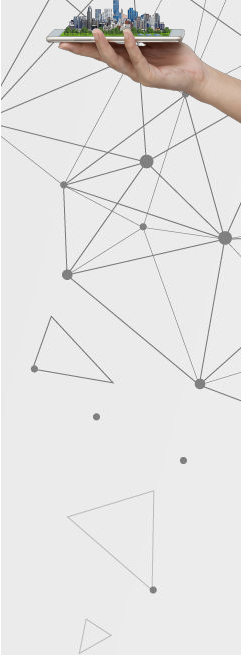
## Environmental Process

- GIS to expedite the impact assessment, enhance quality and credibility of data



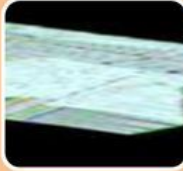
## Inventory Mapping

- GIS, GPS, and LiDAR to map and store assets in a more efficient way
- Track maintenance data of assets, digital records of existing assets



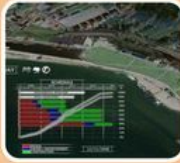
# CIM Functions - Design

- Functions performing *design or design-related tasks* in project delivery process



## Digital design

- 2D digital design tools and nD modeling tools
- Creation of digital models of terrain, project elements



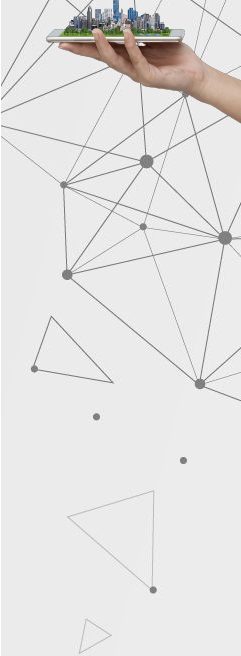
## Design Coordination and Asset data integration

- Using nD models for design and constructability reviews
- Integrating asset identification, attribute data for asset management



## Utility Conflict Analysis

- 2D, 3D, nD modeling, and clash detection tools to detect conflicts
- Reduce Requests for Information (RFI), change orders, and claims.





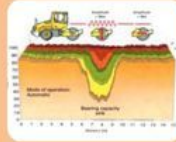
# CIM Functions – Construction

- Functions directly related to *construction* of a project



## Automated Machine Guidance (AMG)

- 3D terrain models and GPS/RTS automate construction operations (excavation, grading, asphalt/concrete paving)
- Increases productivity and safety on-site, reduces rework, and helps in QA/QC checks



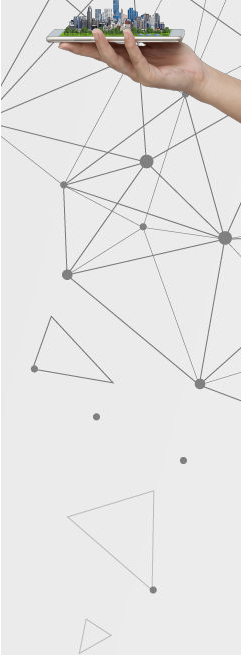
## Intelligent Compaction (IC)

- GPS and IMS to promote efficient compaction of soils and pavements
- Improves quality of pavements
- May result in time/cost savings



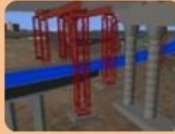
## Remote Equipment Monitoring

- Also known as Equipment Telematics
- Uses GPS/RTN connectivity to remotely monitor and control equipment operations
- Reduces idle time, increases utilization rate, optimizes labor productivity



# CIM Functions – Project Management

- Other functions for *monitoring, controlling and managing* projects



## 4D Scheduling and 5D estimating

- Adds time (4D) and cost (5D) data to the 3D model
- Assists constructability analysis, scheduling, verifying payments, and estimating



## Visualization

- GIS and nD modeling tools to enhance physical, geospatial or functional details of the model
- Communication and public information activities



## Traffic Management Planning

- nD modeling and traffic simulation tools for preparation of traffic control plans



## Construction Quality Control

- Mobile digital devices, RTN and Rover-based QA/QC checks
- Frequent and accurate creation of as-built records and good communication



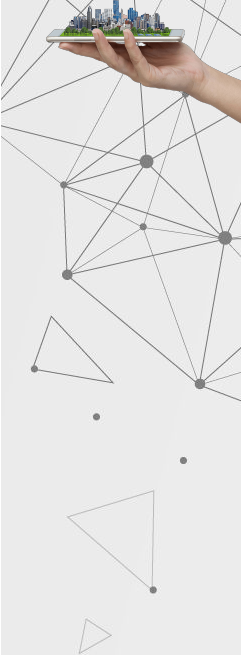
## Materials Management

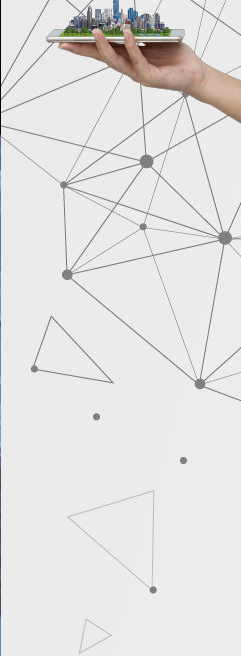
- RFID and GPS technologies to manage materials on supply chain and on-site



## Contracts

- Information management systems for contract administration and management (e.g. bid letting, RFIs, shop drawing reviews and approvals, submittals and correspondences)









## What makes a city smarter?

A smart city should monitor and integrate conditions of all of its critical infrastructures, from roads and bridges to major buildings

- to better optimize its resources
- plan its preventive maintenance activities and
- monitor security aspects
- Smart cities are a move from data silos to data sharing by creating a common object model
- By data sharing it can meet the needs of the many, whether utilities, transport providers, public health, emergency services, asset managers, urban planners, businesses and citizens

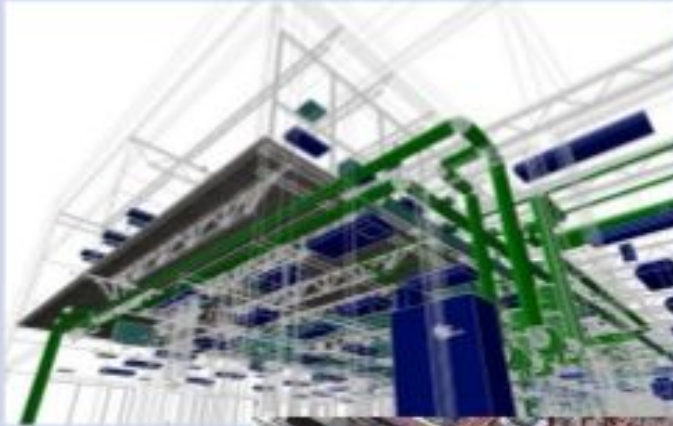
and...

# TECHNOLOGY Makes It Happen

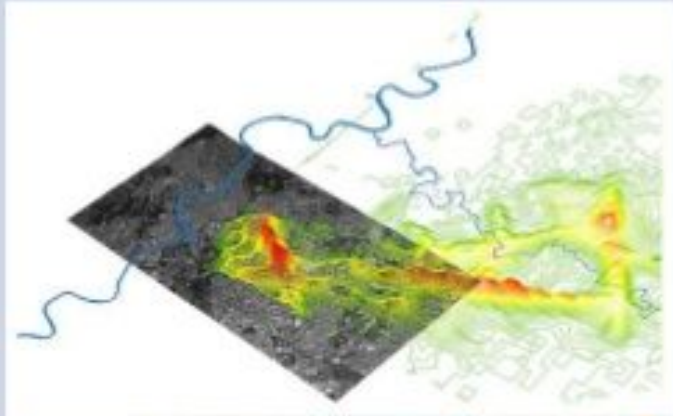


- BIM data and GIS data are xenogeneic data.

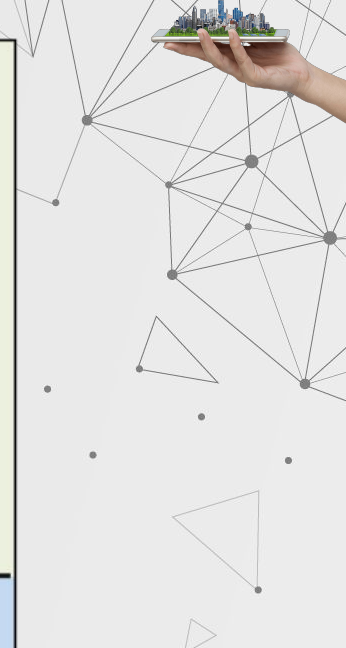
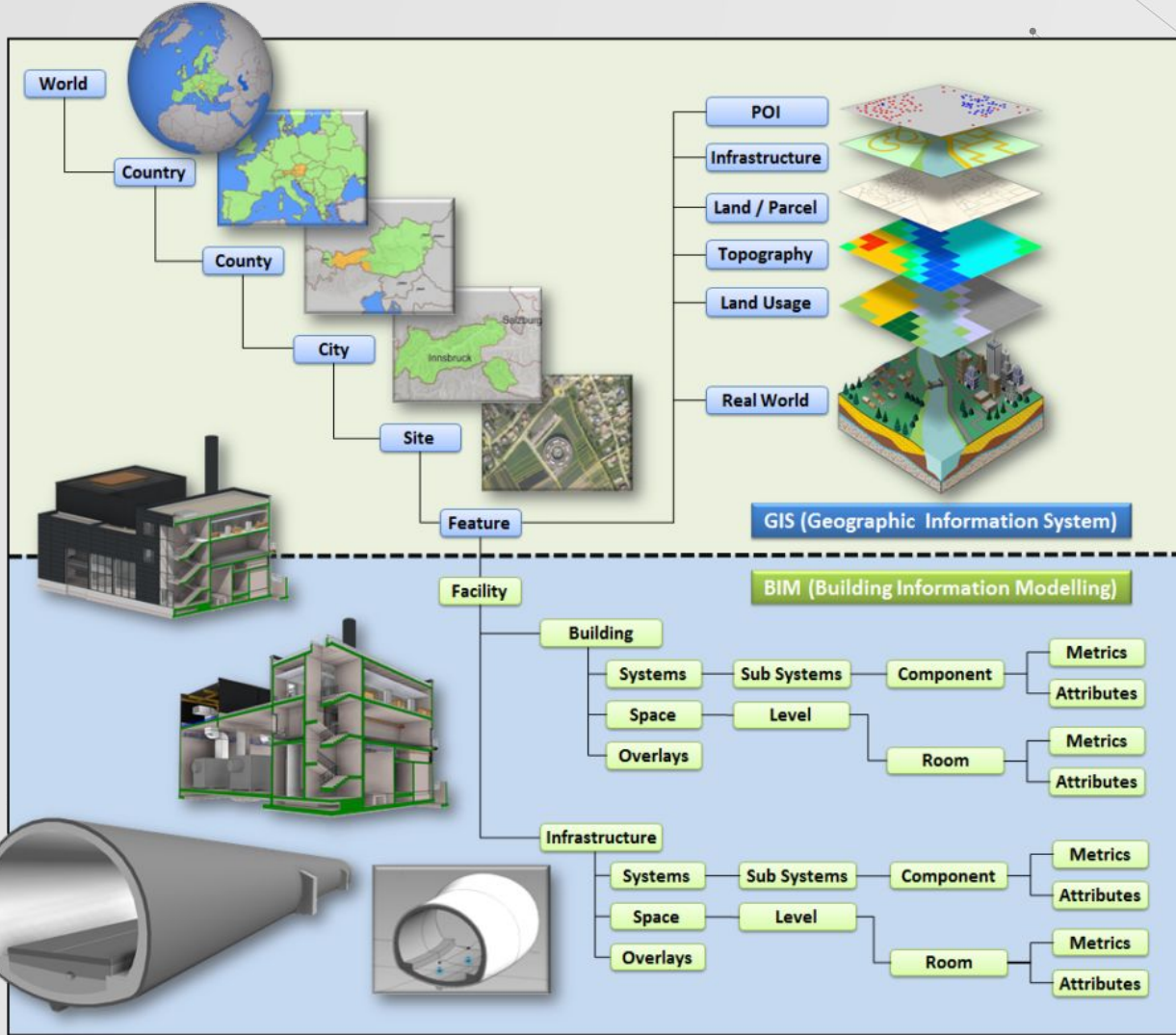
## BIM data



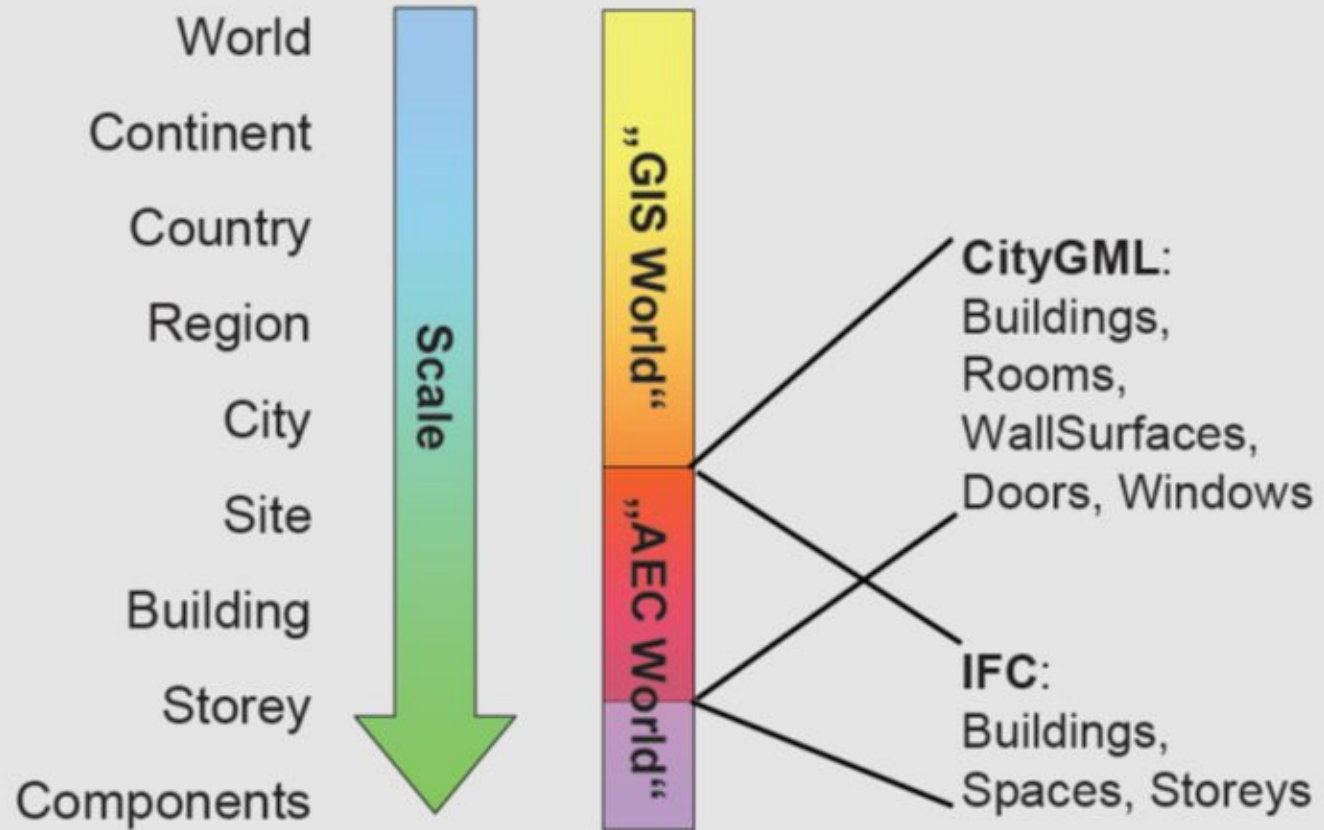
## GIS data

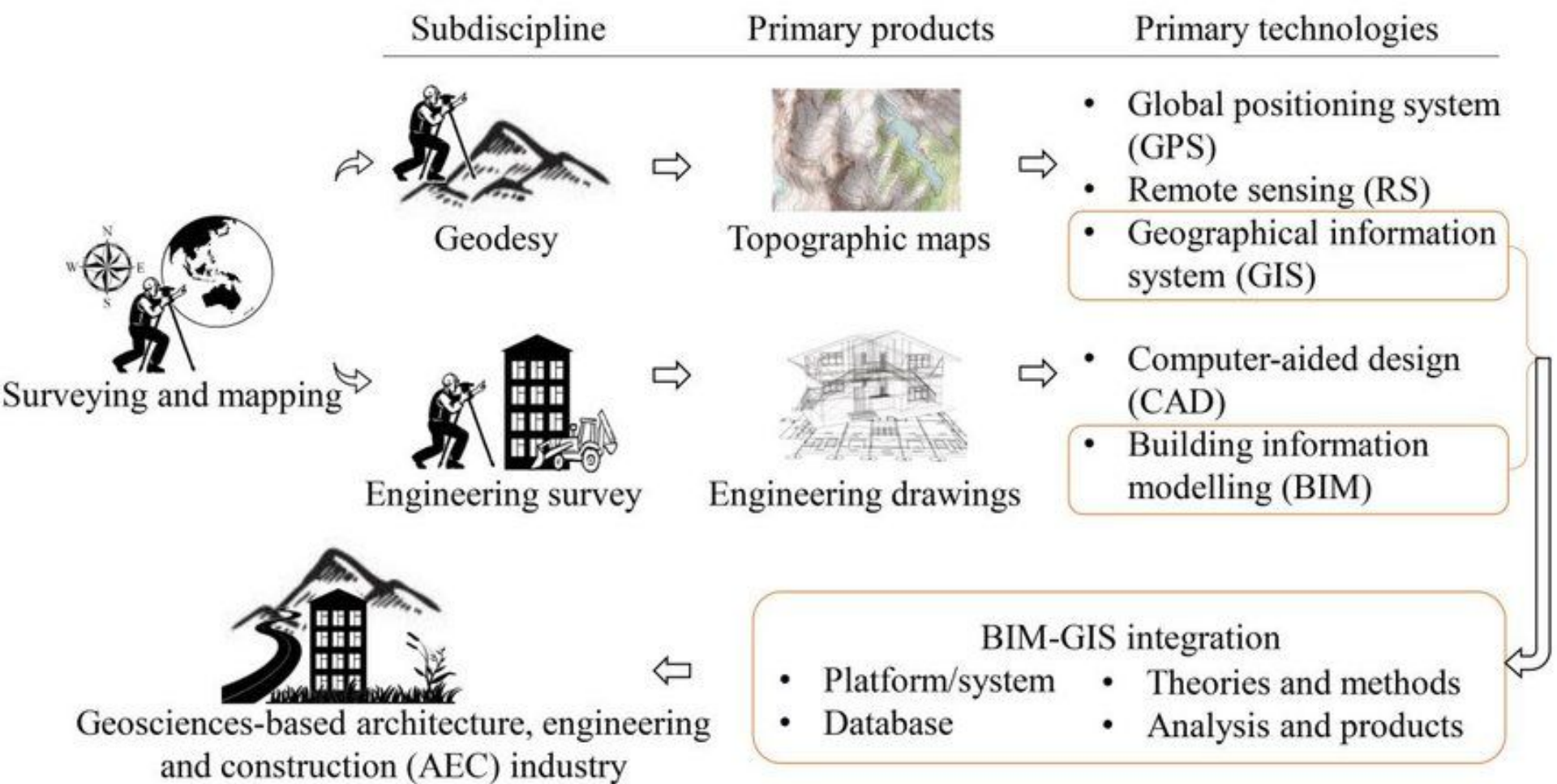






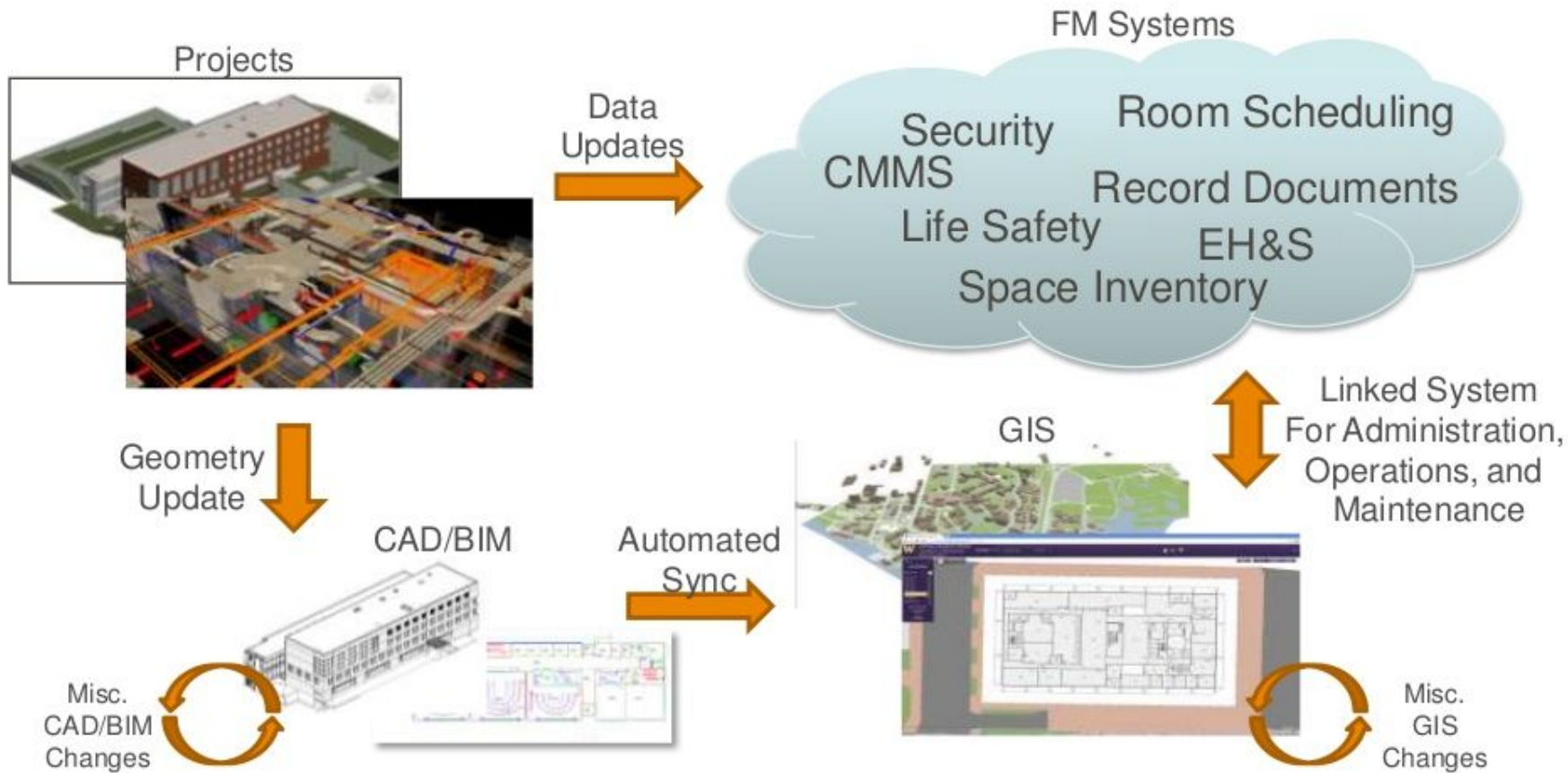
# CityGML and BIM / IFC





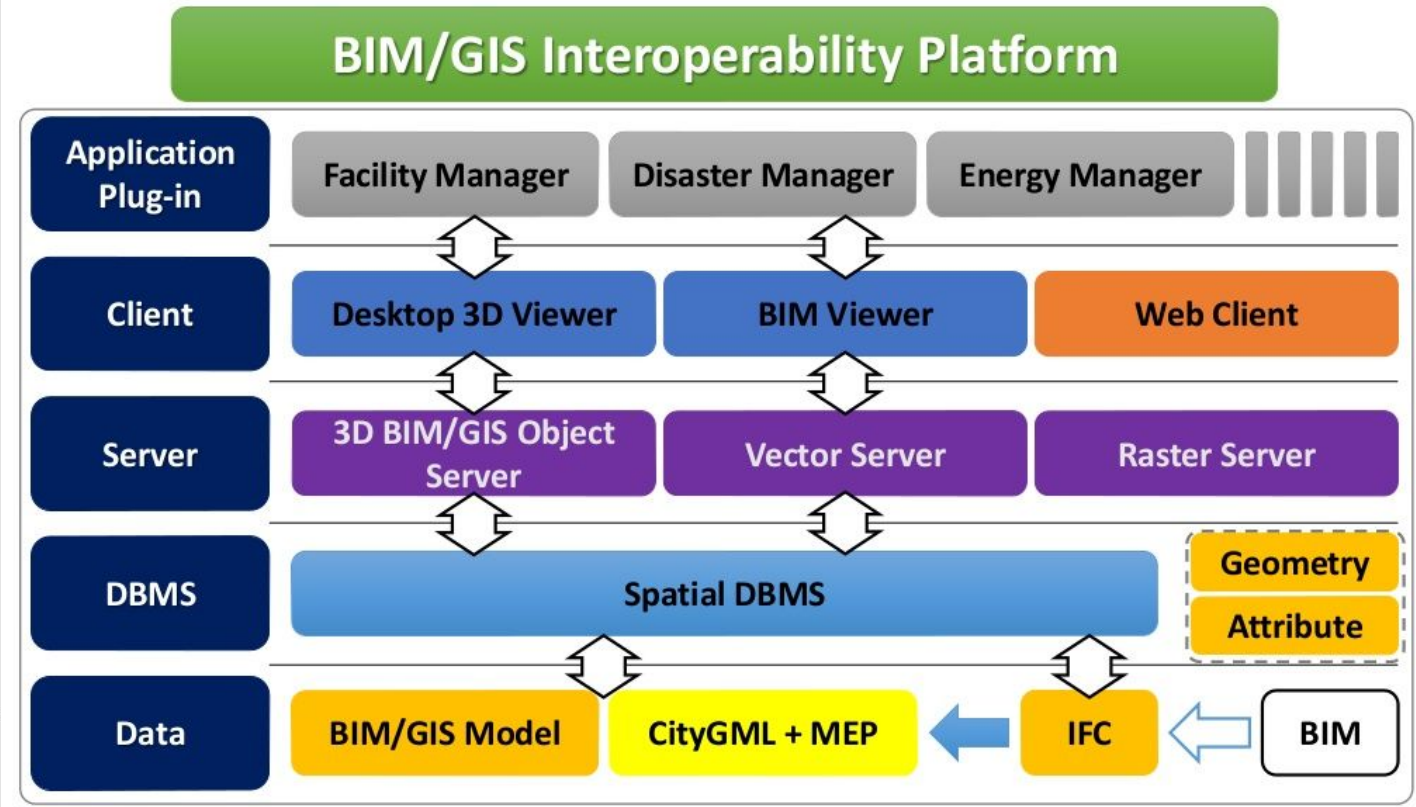
History of BIM-GIS integration from the perspective of surveying and mapping





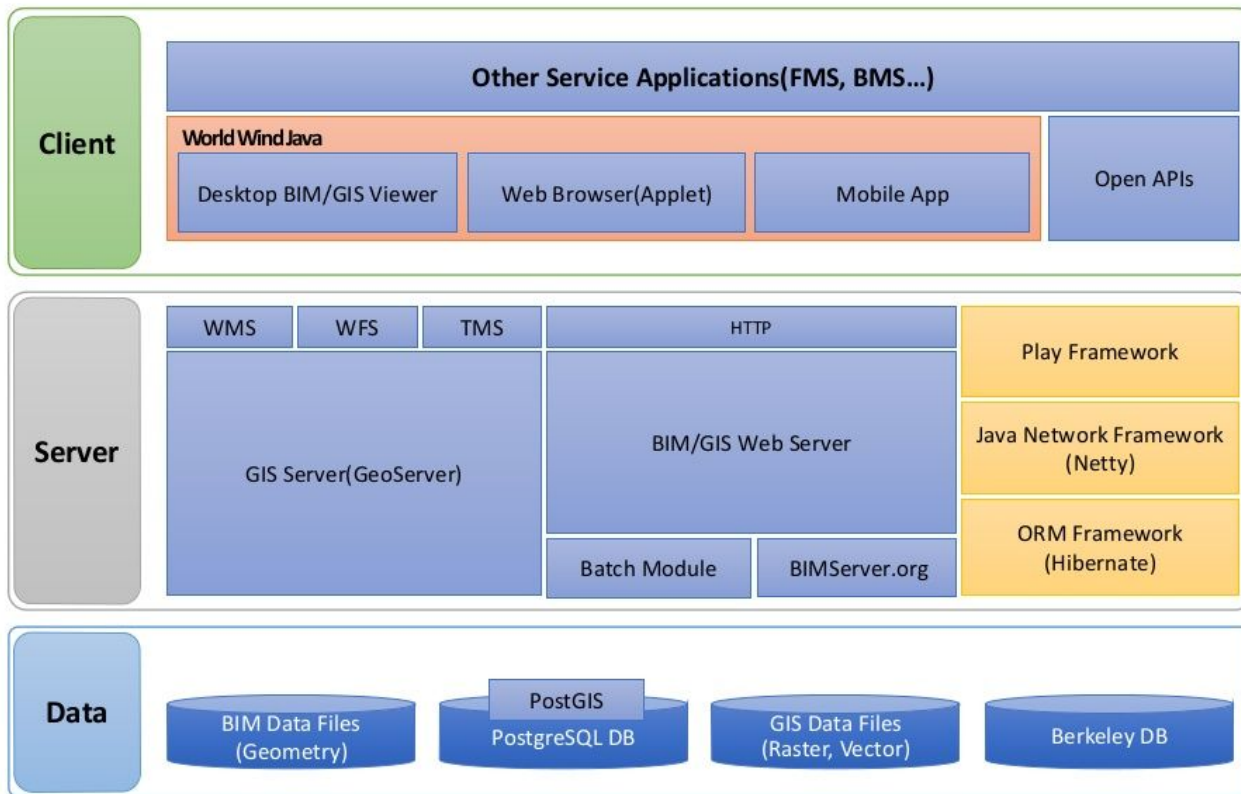
# System Architecture for BIM/GIS Interoperability Platform

- For interoperable BIM on GIS platform, complicated system is required.



# Platform Architecture

- Target platform should provide accessibility, interoperability, scalability, and compatibility.

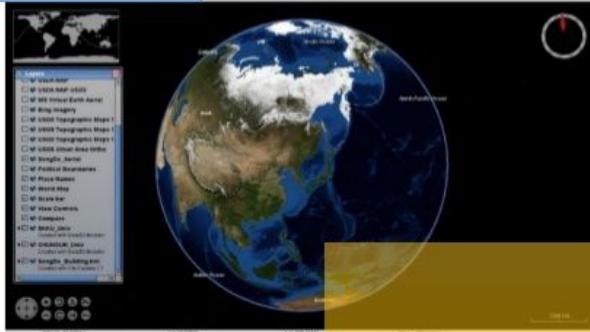




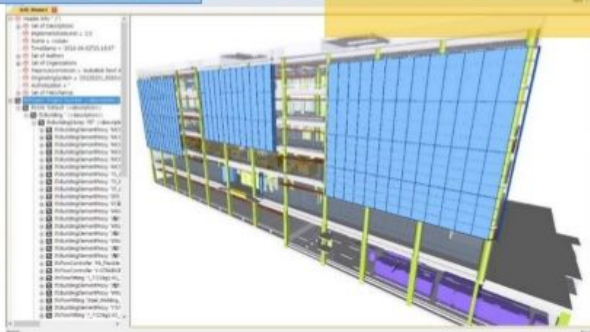
# Client Development

- Out target is to integrate BIM data into 3D GIS data.

## 3D GIS



## BIM Viewer



## 3D GIS + BIM



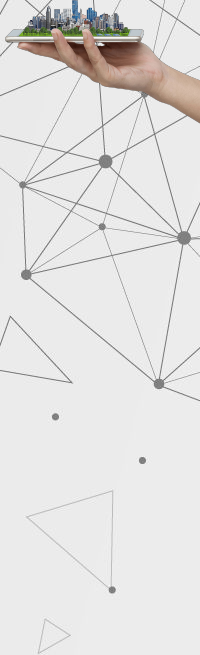
- Seamlessly connecting indoor and outdoor
- Interactively viewing inside and around the building
- Easily searching properties of the building

## World Wind Java for 3D GIS

- World Wind is an open-source (released under the NOSA license) virtual globe developed by NASA and the open source community for use on personal computers.
- Old versions relied on .NET Framework, which only ran primarily on Microsoft Windows. The more recent Java version, World Wind Java, is cross platform.
- World Wind Java is a Software Development Kit (SDK) which is aimed at developers and is not a standalone virtual globe application in the style of Google Earth

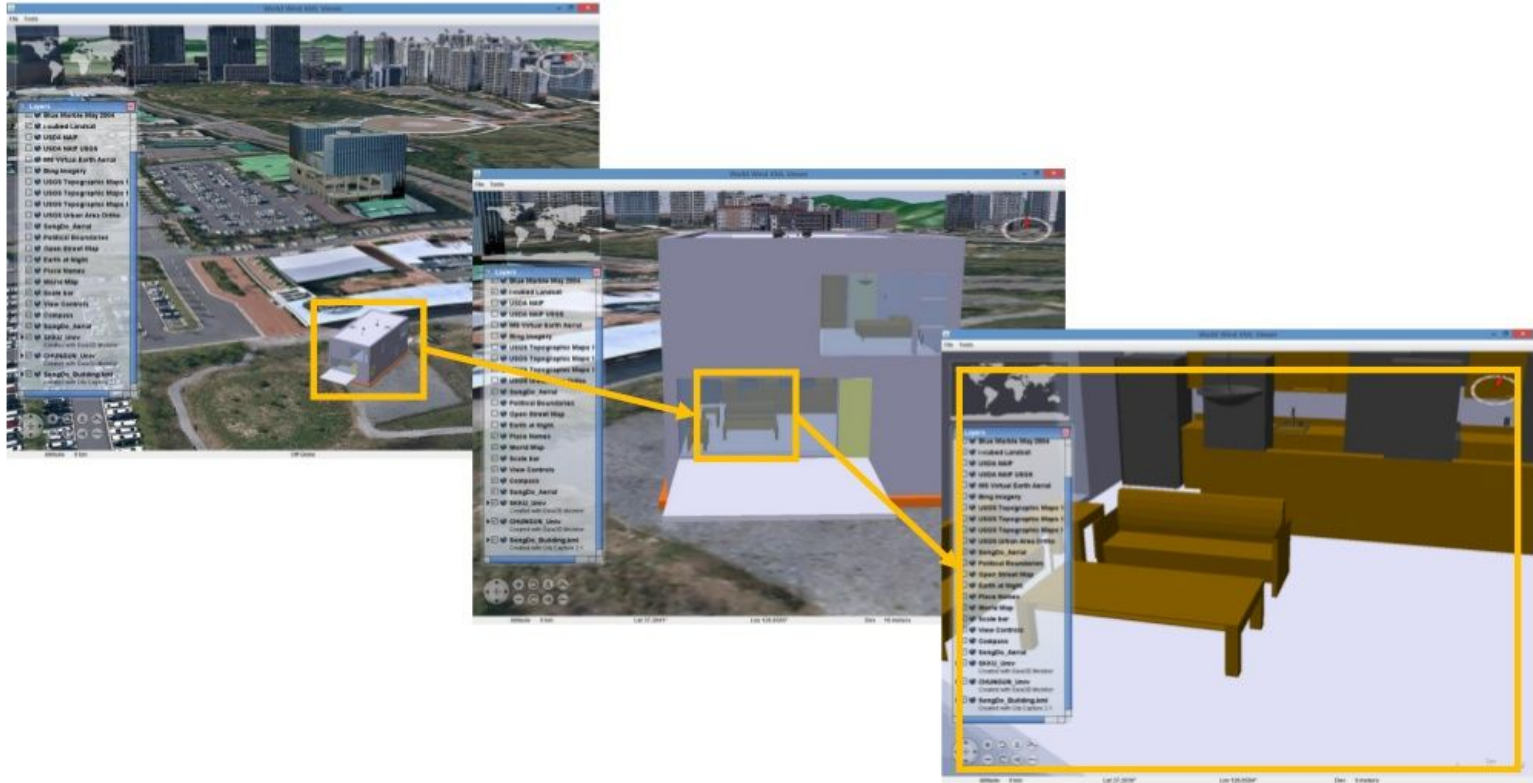
# Client Development

- Providing satellite image/aerial photo service using WMS (Web Map Service) from GIS server
- NASA Blue Marble Imagery, I-cubed Landsat Imagery, Aerial Photo(12cm Spatial Resolution)



# Client Development

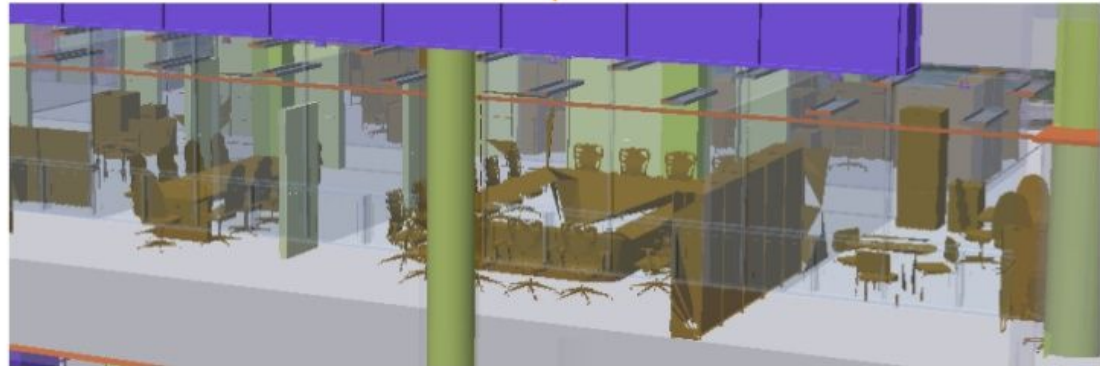
- Displaying inside and outside of building via BIM/GIS interoperability service
- Displaying BIM data with relative coordinate on absolute coordinate based WWJ based on georeference information of spatial data link model(G3D)

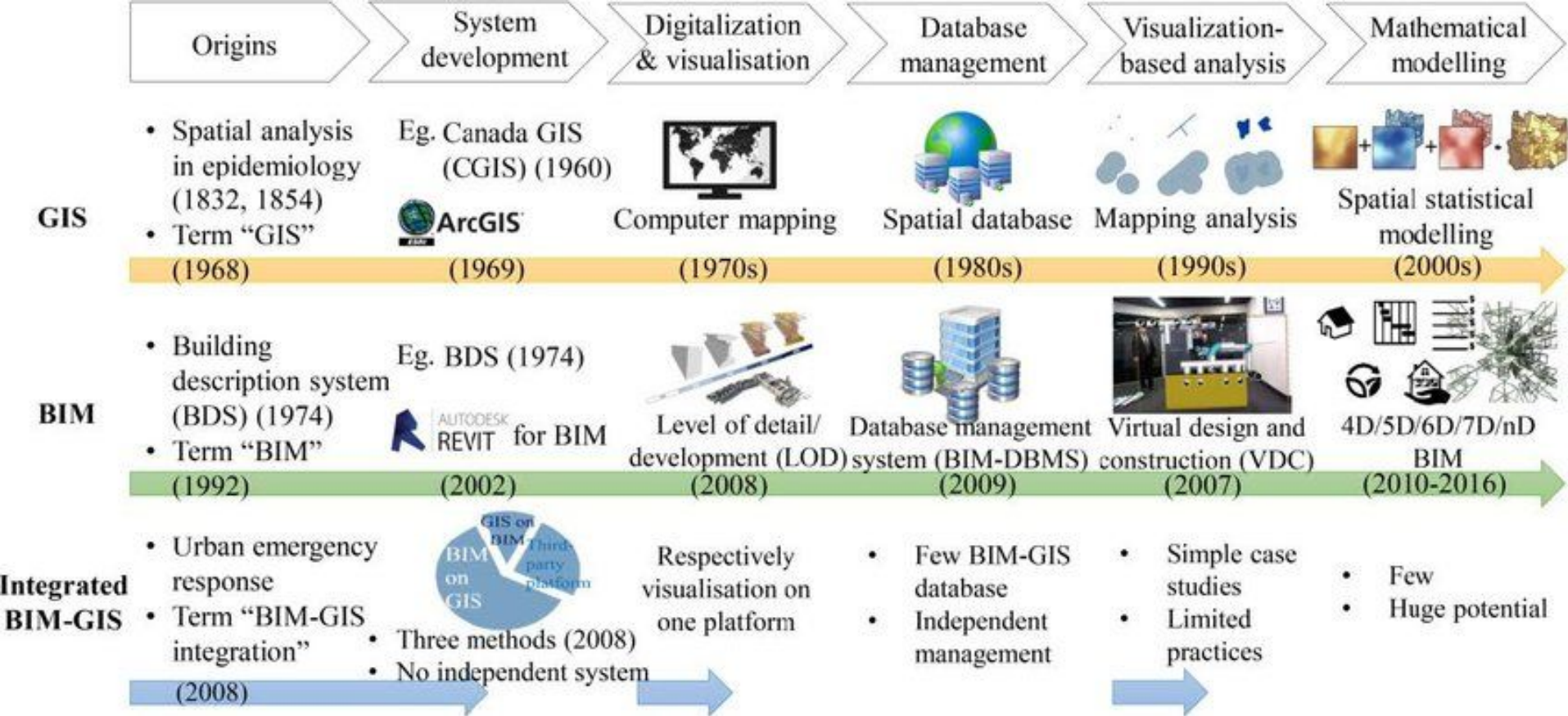




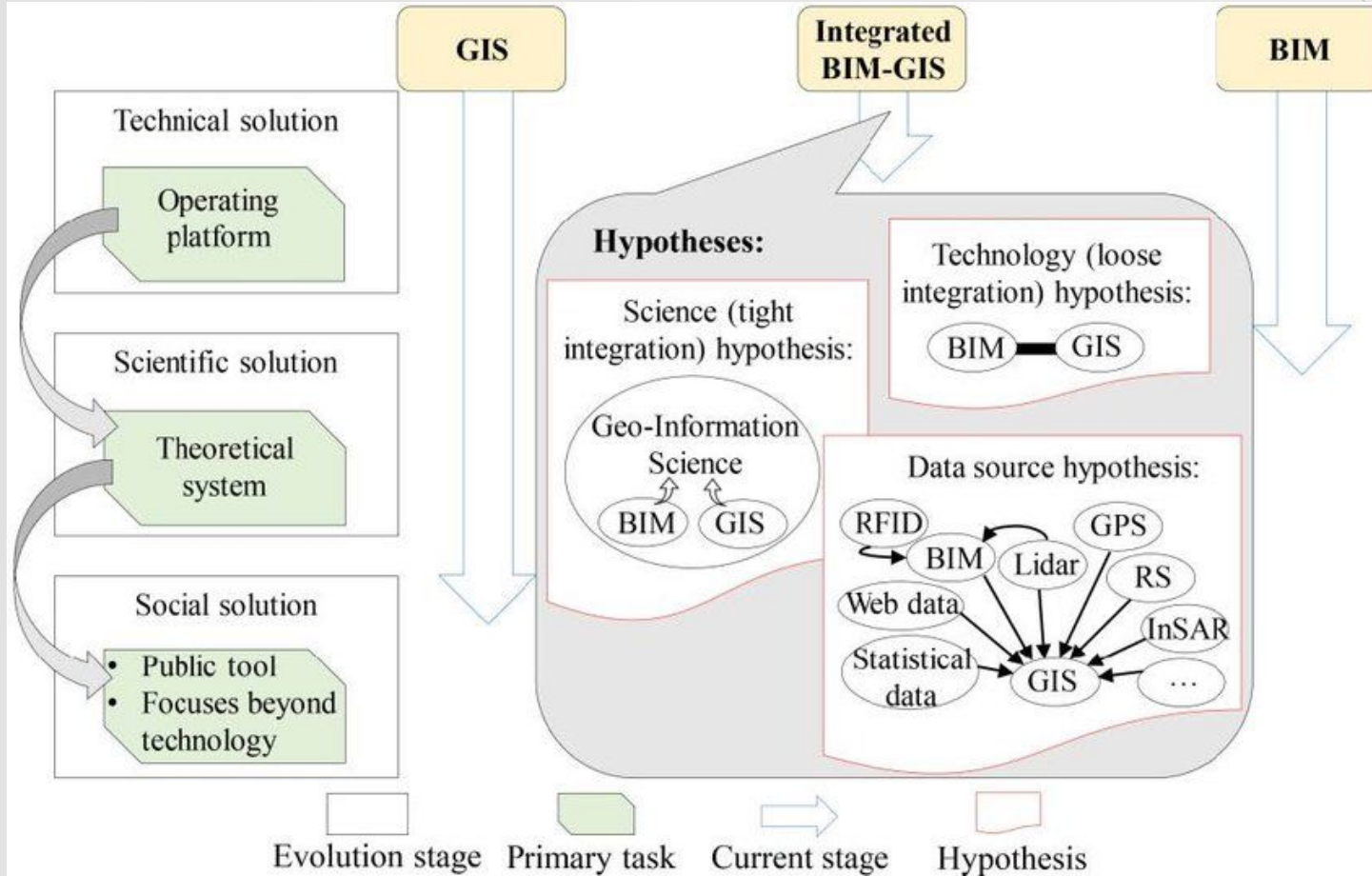
# Client Development

- BIM data(IFC) visualization – Visualizing inside and outside building





Comparison of evolution progresses of GIS, BIM and integrated BIM-GIS



Hypotheses of future development of BIM-GIS integration



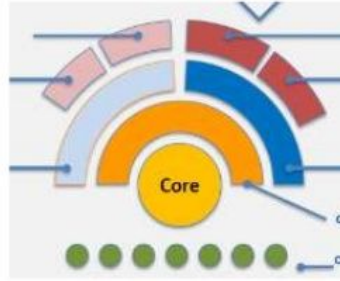
# CityGML – the basics

- Application independent topographic information model for virtual 3D city models
- Basic set of features defined
- Standardised meaning/interpretation of feature types (UML/GML)
- Comprises different themes – buildings, relief, water body, vegetation, landuse, appearance, city furniture, generic objects etc
- Data model (UML) ISO 191xx standard family
- Exchange format
- Realised as a GML3 application schema
- Applications – city planning, architectural design, environmental, telecoms, disaster management, estate management, etc
- August 2008 – cityGML version 1.0.0 accepted as an official OGC standard





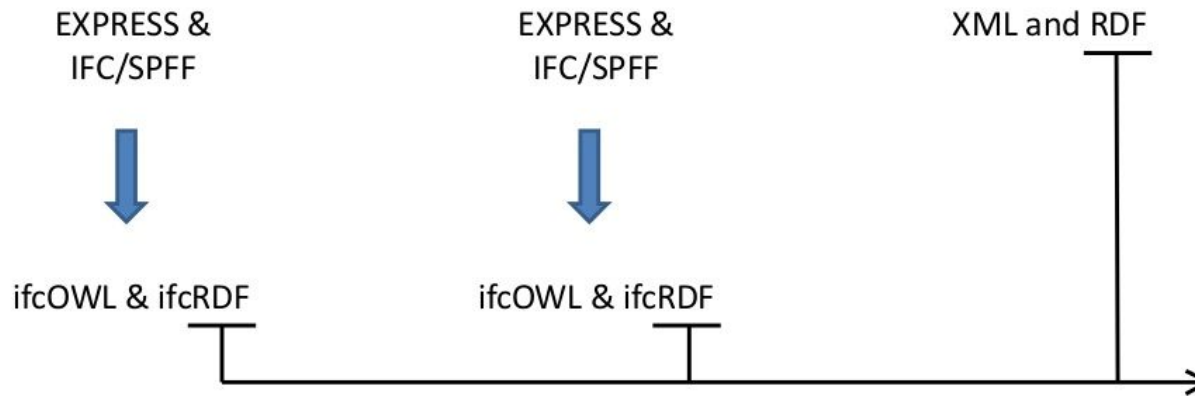
BIM



INFRA



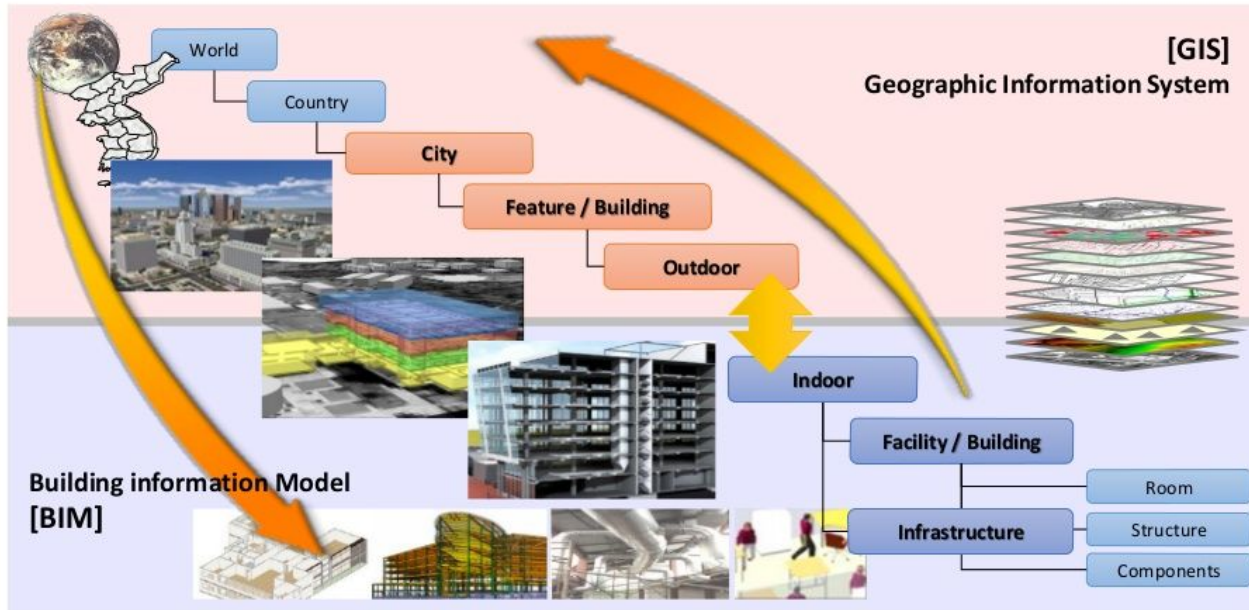
GIS



SOURCE: P. Pauwels & W. Terkaj. EXPRESS to OWL for construction industry: Towards a recommendable and usable ifcOWL ontology. Automation in Construction 63, pp. 100-133.

# BIM on GIS project

- Data model to integrate BIM data with GIS data to seamlessly and freely connect indoor to outdoor
- BIM and GIS interoperability platform for various applications and services
- Collaborative research project of Korea Institute of Construction Technology(KICT) and Gaia3D, Inc.,

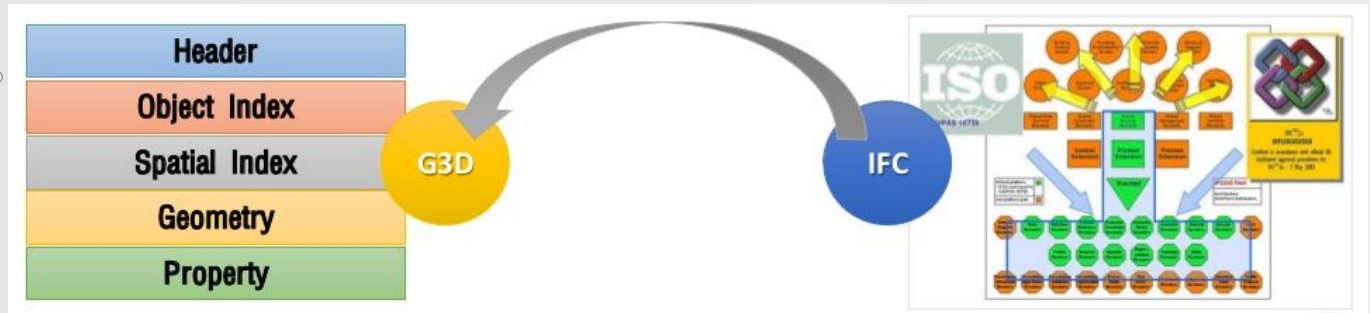




# Service Model of IFC for Interoperability








- Service Model: IFC conversion format for BIM/GIS interoperability
- G3D is designed for rapid display of big size IFC data based on GIS
- Characteristics of G3D
  - Including IFC geometry and property information
  - Relative coordinate + Georeference information (Latitude, Longitude, Altitude, Direction, Etc.)
  - LOD and spatial indexing information for rapid display
  - Geometry information based on file system
  - Property information based on database (ongoing)

Industry Foundation Classes (IFC) data model is intended to describe building and construction industry data. It is a platform neutral, open file format specification that is not controlled by a single vendor or group of vendors. It is an object-based file format with a data model developed by buildingSMART (formerly the International Alliance for Interoperability, IAI) to facilitate interoperability in the architecture, engineering and construction (AEC) industry, and is a commonly used collaboration format in Building information modeling (BIM) based projects



# Designing Level of Detail(LOD)

- Newly defined LOD for BIM on GIS based on CityGML and BIM data type

Space	LOD	Geometry			Properties (Semantic LOD)
		BIM data	GIS data	Shape	
Outdoor	LOD0	-	<ul style="list-style-type: none"> <li>Only terrain data</li> <li>DEM+orthoimage</li> </ul>		<ul style="list-style-type: none"> <li>None</li> </ul>
	LOD1	<ul style="list-style-type: none"> <li>Boundary model</li> <li>Prismatic buildings</li> <li>Virtual texture</li> </ul>	<ul style="list-style-type: none"> <li>DEM+orthoimage</li> <li>Prismatic buildings</li> <li>Virtual texture</li> </ul>		<ul style="list-style-type: none"> <li>General properties</li> </ul>
	LOD2	<ul style="list-style-type: none"> <li>Boundary model</li> <li>Simple roof structures</li> <li>Photorealistic texture</li> </ul>	<ul style="list-style-type: none"> <li>DEM+orthoimage</li> <li>Simple roof structures</li> <li>Photorealistic texture</li> </ul>		<ul style="list-style-type: none"> <li>Floor specific properties</li> </ul>
	LOD3	<ul style="list-style-type: none"> <li>Boundary model +Parametric model</li> <li>Representation of precise Object</li> <li>Photorealistic texture</li> </ul>	<ul style="list-style-type: none"> <li>DEM+orthoimage</li> <li>Representation of precise Object</li> <li>Photorealistic texture</li> </ul>		<ul style="list-style-type: none"> <li>Exterior properties</li> <li>Facilities' exterior properties</li> </ul>
Indoor + Outdoor	LOD4	<ul style="list-style-type: none"> <li>Boundary model +parametric model</li> <li>Building envelope</li> </ul>	<ul style="list-style-type: none"> <li>DEM+orthoimage</li> <li>Representation of precise Object</li> <li>Photorealistic texture</li> </ul>		<ul style="list-style-type: none"> <li>Building envelope properties</li> </ul>
Indoor	LOD5	<ul style="list-style-type: none"> <li>Parametric model</li> <li>Building envelope</li> </ul>	-		<ul style="list-style-type: none"> <li>All properties of buildings</li> </ul>
	LOD6	<ul style="list-style-type: none"> <li>Furniture, MEP model</li> <li>Irregular shaped objects</li> </ul>	-		<ul style="list-style-type: none"> <li>All properties of buildings</li> </ul>

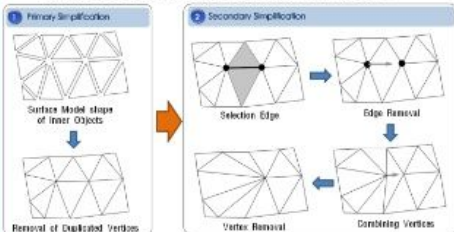
# Technology for Rapid Display

- Simplification, Hierarchical, and Data Streaming are required for rapid display.

## Simplification

Hierarchical LOD generation throughout applying simplification algorithm

- Simplification of building inside
- Simplification of building envelope



- Building inside objects simplification and LOD creation



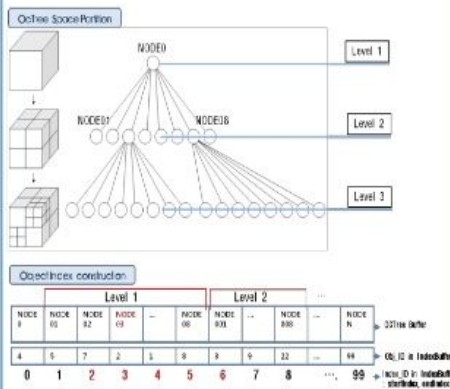
- Building outside objects simplification and LOD creation



## Hierarchical Data Structure

Data structure throughout spatial indexing based on Octree

- Spatial division method based on Octree for spatial query about building objects
- Applies Octree to all LOD including interior and exterior



## Data Streaming

High speed rendering throughout data streaming and visualization

- Proper LOD level display from screen division
- Improving rendering speed throughout loading necessary data
- Multi-threading
- Efficient memory resource management

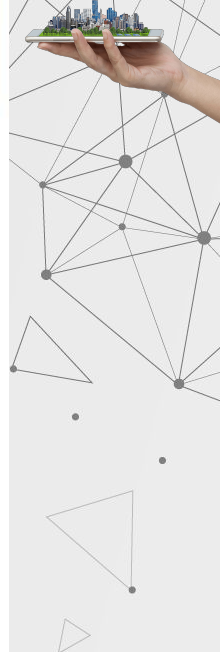
Best Screen Division

Hierarchical LOD

Effective Memory Mgmt.

Data Search/  
Compression/  
Sending

Cont. Screen Display







## GeoDesign Data

BIM Data

GIS Data

Data Analysis

ETL Data Transformation

## 3D GeoDesign Data Base

BIM

GIS

## Project Assessment & Optimization

Project design and execution by planners

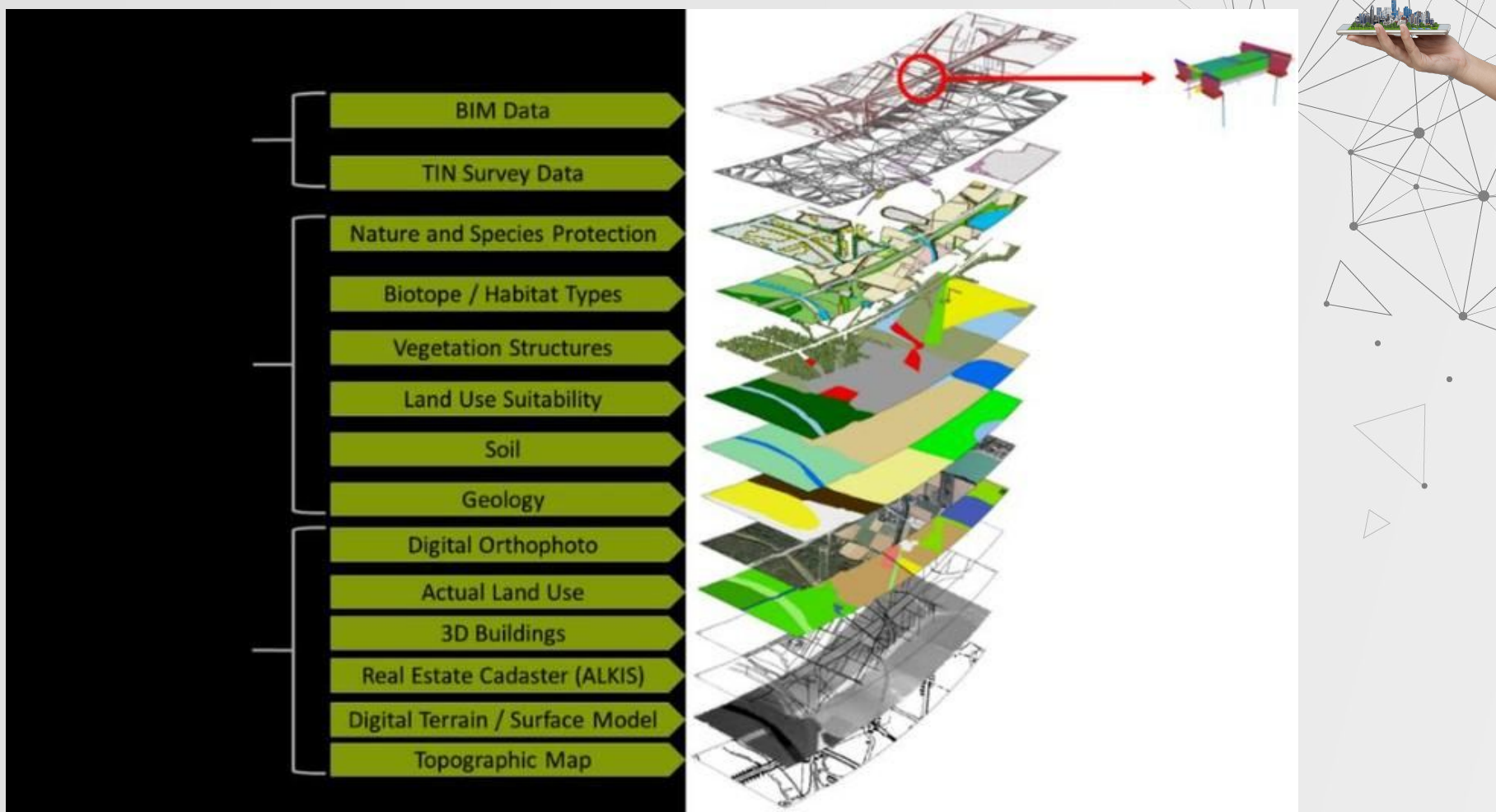
Results

Feedback and Update

PLANNING AND IMPLEMENTATION PROJECT

→ → → → Project Phases → → →

The integrated data exchange concept



Integration of BIM data and GIS environmental planning data

## 2D/3D GIS Database

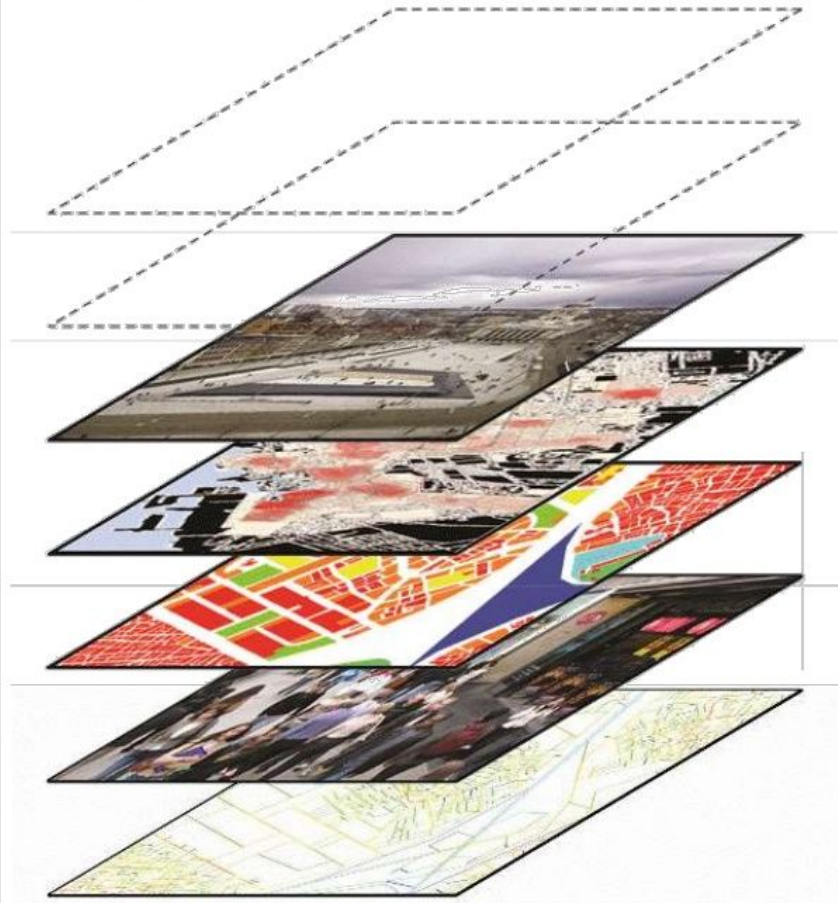






Integration of Autobahn A99 BIM data (circled bridge) into the 3D GIS and environmental planning data model

# Integrated Urban Model



**5. Carbon Emissions**

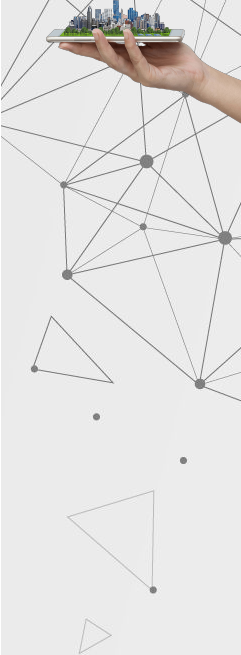
**4. Land Value**

**3. Crime & Safety**

**2. Land Use**

**1. Movement**

**0. Spatial Layout**



The big challenge is communication

- Between systems
- Between data formats
- Between organisations
- Between disciplines
- Between different roles



International  
Organization for  
Standardization

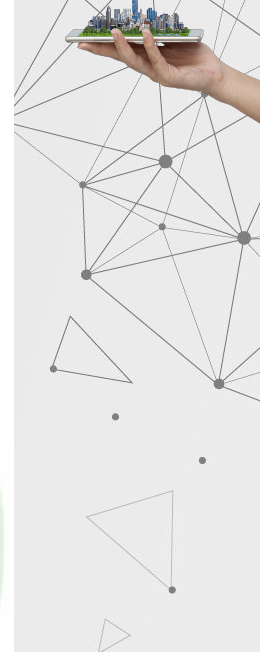
OGC<sup>®</sup>

Open Geospatial Consortium, Inc.

buildingSMART<sup>®</sup>  
International home of openBIM







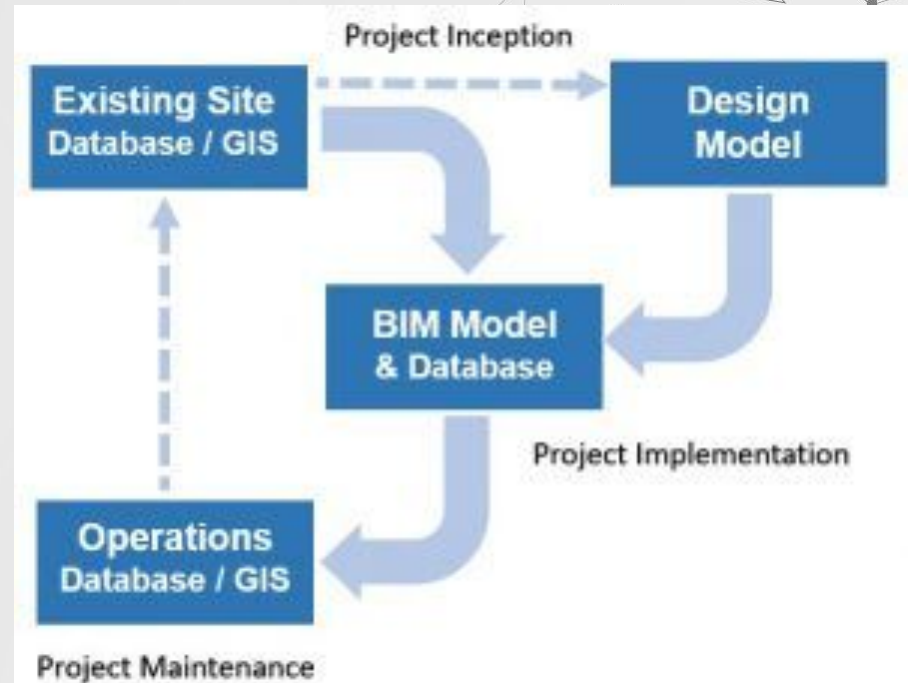
# Background

- Usage of GIS is still in growing state.
- Organisations are trying to conceptualise BIM and find ways to use this technology
- Coding in every details of a building ( any type) + analysis is BIM.
- It needs very detailed attribute information in terms of design specifications, standards and rules well before the development of the asset.



# Perceived value

- GIS and BIM are seen as technical tools for improve designs.





# Why to Integrate

- To understand the need for integration lets run through a example.

Case:

A fast developing city selected to be host of a global sport event in 2022, geared up to spend US\$75b in 12 years time. As part of the preparation host city wants to develop some part of city and create a world class living, business and entertainment district.



# Full cycle sustainable development

Scope of the project is to deliver design & develop a green field site of about 80 sq.km



Urban design  
&  
Architecture

Detailed  
Engineering

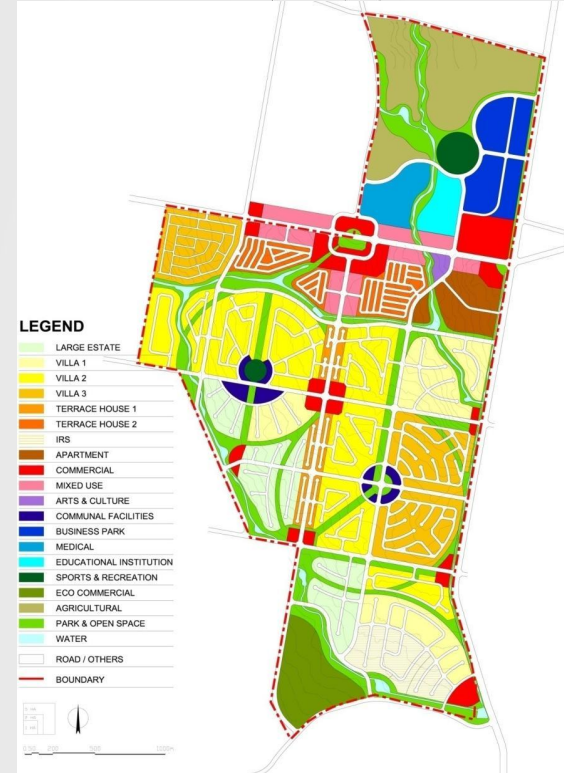
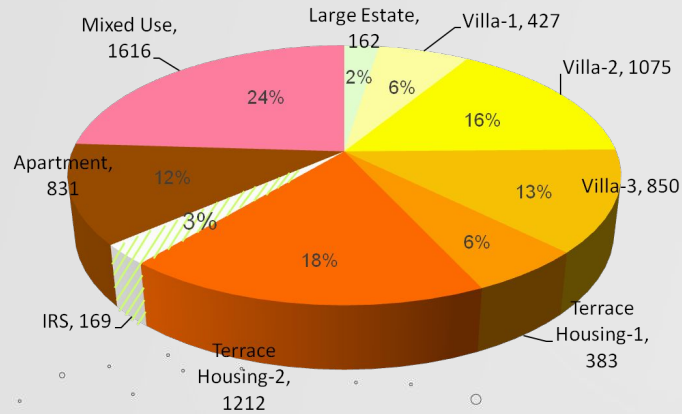
Construction



Maintenance

# Land use plan & Zoning

## DEVELOPMENT QUANTUM: DU





# Example: The Urban Water Cycle



- Demand reduction
- On premise leaks & waste
- Discharge to sewers

Consume

Locate



- Recovery of treated water
- Hydrological modeling
- Weather modeling
- Water Rights



Deliver

- Asset management
- Flow management
- Leaks and overflows
- Interactions with traffic

Capture and Store

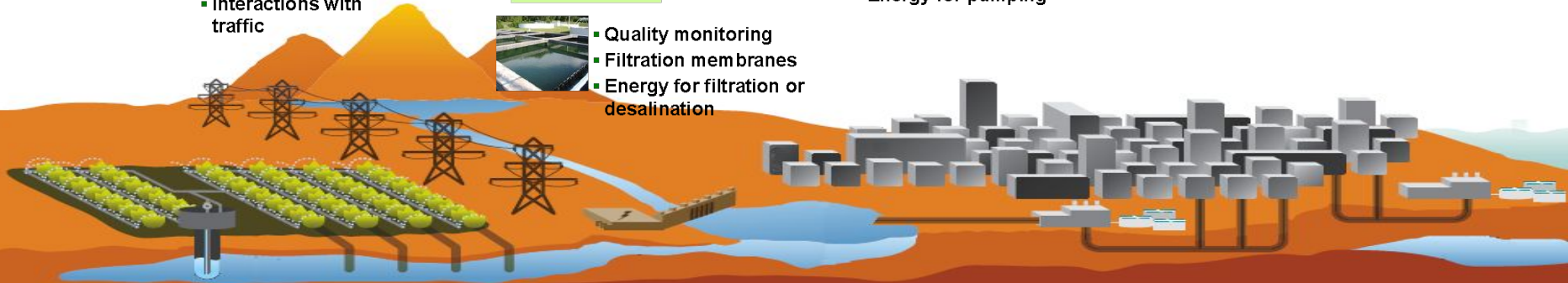


- Quality monitoring
- Weather modeling
- Energy for pumping

Clean/  
Desalinate



- Quality monitoring
- Filtration membranes
- Energy for filtration or desalination



# Systems Effects and Resources Constraints



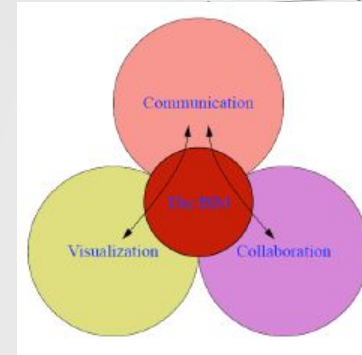
- “Slack” or excess capacity produces weak interactions
- Interactions become stronger when resources are constrained
- Under severe constraints – tipping points
- Examples:
  - Energy: MASDAR, Malta, Canary Wharf/London, Lower Manhattan....
  - Water: Middle East, US Western States, China (2030)
  - Transportation: Mexico City, Stockholm, China, India
  - Finance: <pretty much everywhere>
  - Economic Development: <pretty much everywhere>
- Conclusion: In the future, we need to take a systems view of the development and management of cities and regions

***“The BIM is a tool which facilitates the flow of information and helps to create understanding and collaboration.”***

The three primary ‘project enabling’ principles are:

1. **Visualization** – the ability to form a picture in our head based on understanding information.
2. **Communication** – the transfer of information which leads to understanding.
3. **Collaboration** – the mutual support which leads to common understanding and positive action.

Communication connects Visualization to Collaboration.



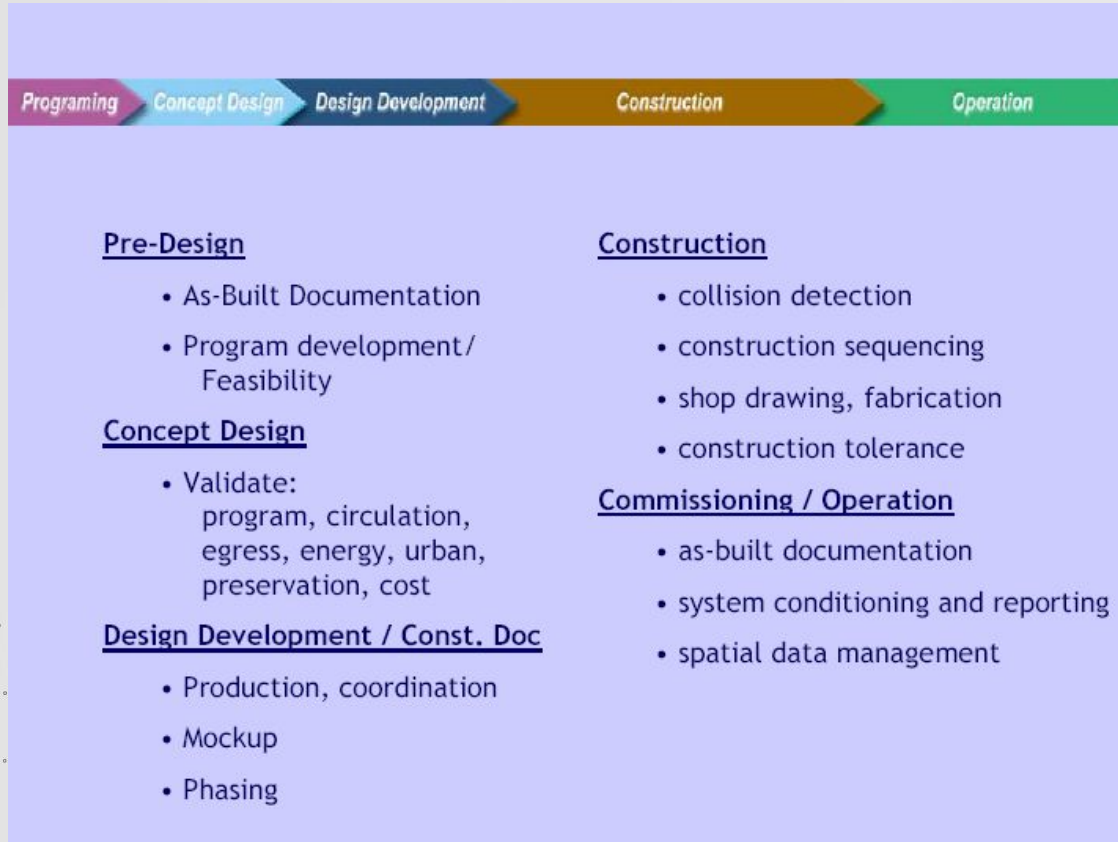
***“Creating the BIM is an action which will generate more understanding of the project particulars than any other activity related to the design and construction process.”***

***“A BIM is as good as the (both project and process) understanding of the team which creates it.”***

## **Outline for a BIM Curriculum.**

By Willem Kymmell, architect  
Assoc. Prof. Construction Management  
Founding partner - Construction Simulation Lab  
CSU Chico, Chico, CA  
[wkymmell@csuchico.edu](mailto:wkymmell@csuchico.edu)

# BIM as an integrative





# BIM Levels of Information

## Stepped Strategy of Data Collection and Modeling

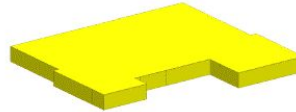
Minimal level of data modeling necessary to integrate BIMs with other data?

Surprising little is needed to get the highest value from the BIMs.

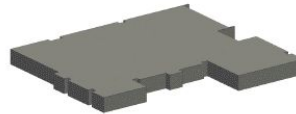
Value comes over time in a logical stepped sequence of data collection.



*Simple Mass Defining Total Square Footage 16,900 SF*



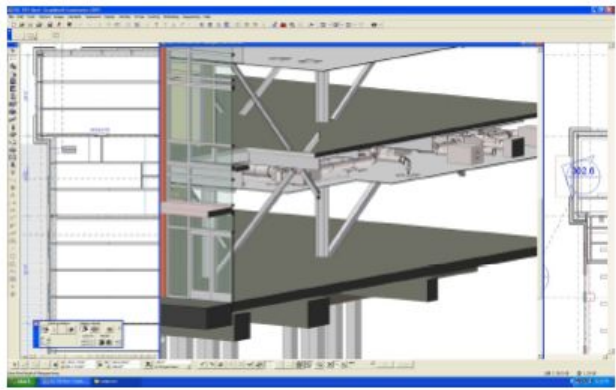
*Mass With Rough Outline Defining Total Square Footage 16,900 SF*



*Mass Accurate Outline Defining Total Square Footage 16,900 SF*

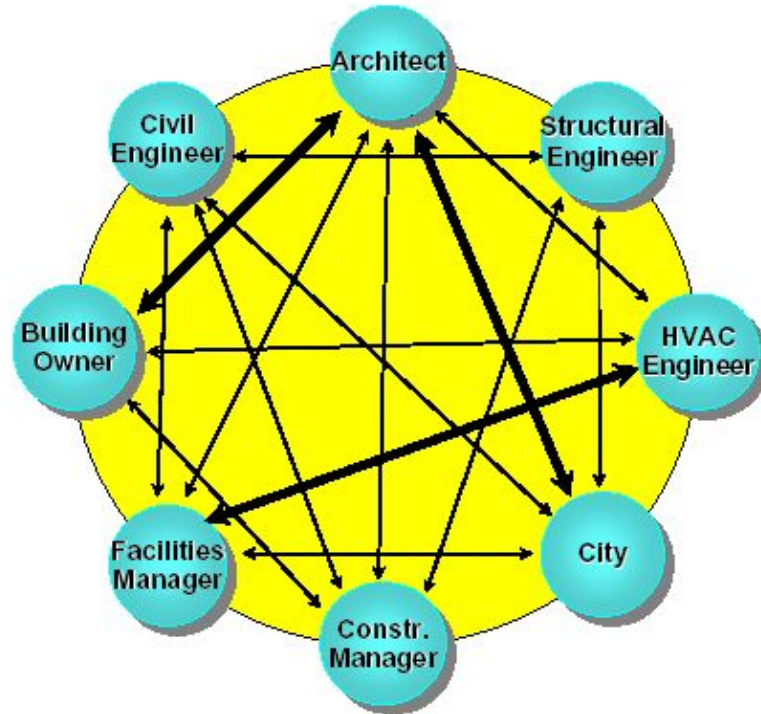


*All of the levels can reference data that exists in other levels of detail.*



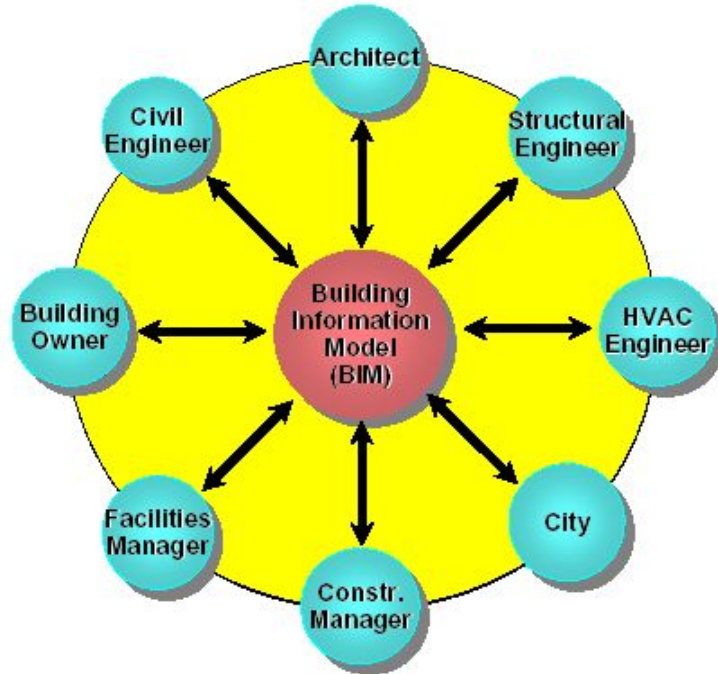


# Traditional Information Exchange





# building**SMART** Information Exchange





# Pushing the Standards Edge: Collaborative Testbeds to Accelerate Standards Development and Implementation

## What Drives OGC Standards Development?



Tackling major interoperability challenges of next-generation data / service sharing and collaboration....

Developing new specifications for location-based services interoperability and spatially enabling the systems and enterprises

Working across standards consortia to accomplish mission objectives

# OWS-4 CAD / GIS BIM Integration

## BIM In Context for Project Development



AEC Projects will benefit by integrating BIM in geospatial context throughout **project** lifecycle:

- Initial ground condition from OGC Standards Based systems will aid in initial site planning
- Existing and surrounding site buildings may be delivered as CityGML, an XML encoding based on OGC's Geography Markup Language
- Detailed engineering connections and conflicts may be understood and modeled by integration of BIMs of neighboring sites



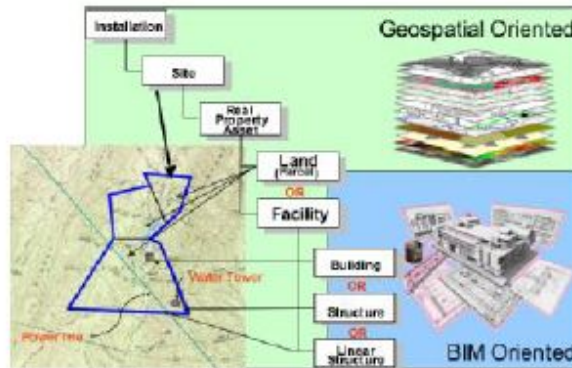
# OWS-4 CAD / GIS BIM Integration

## BIM In Context for Project Development



Broad-scale assessment will be facilitated by integration of information aggregated from **multiple** BIMs:

- Space Planning
- Facilities Management / Security
- Build-Out Analysis
- Emergency Planning/Management
- Detailed, 4-D Virtual City Application



Source: DoD/FRPC

# <http://www.opengeosp>

## CAD / Geospatial / 3D Integration



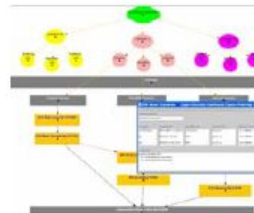
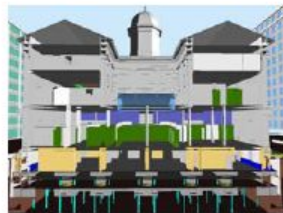
**Open Standards approach to sharing of information and services between AEC / CAD and geospatial technologies**

**Critical for Urban Planning, Emergency Response, Homeland Security, Defense and Intelligence, site planning, Maintenance, Engineering...**





GSA's mission is to "help federal agencies better serve the public by offering, at best value, superior workplaces, expert solutions, acquisition services and management policies."

[illegible]

*Images from GSA Pilot Project applications of 3D, 4D, and BIM technologies*

- Increased Security Requirements
- Rising Energy Costs
- Cost of Construction Materials
- Changing Customer Requirements

# Challenges Facing the Organization

- Helps Customers Make Informed, Rational Security Decisions
- ID Security Gaps
- Aligns with Interagency Security Committee Design Criteria

- Plan & Mitigate Risk
- Identify Gaps in the Design Phase
- Identify Whether Designs Meet Specific Objectives and Criteria
- Identify Problems with the Project Budget
- Communication Tool for Customers



- US General Services Administration (GSA),
- 'virtual building models'
- use and deliver **digital datasets** for facility operations, maintenance and renewal;
- support improved service delivery, enhanced emergency planning, management and response.

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## CAPITAL INVESTMENT & LEASING PROGRAM CALL

**FY 2008**U.S. General Services Administration  
GSA Public Buildings Service  
Office of Real Property Asset Management<http://www.gsa.gov/procurement/oca-gs>Public Buildings Service  
Office of Real Property Asset ManagementMulti-Phase R&A Projects  
Design Build  
Export Choice  
5-Year Capital Reinvestment Plan  
SUMMARY OF R&A REQUIRED DDC  
SUBMITTED BY THE REGIONS INProspectus  
Housing Plan  
Feasibility Study  
Program Development Study  
Project Management Plan  
Project Data Sheet  
The Automated Prospectus System  
GCCRG Cost Benchmark Tool  
Pro Forma  
Appraisal  
Any MV appraisal that does not meet  
instructions will decrease the project  
Project Cost Estimating Tool  
Design & Construction Professional  
Project Definition Rating Index (PDRI)  
LEED Certification  
Environmental Review Sheet  
EIR/IEIR 300  
Judiciary Impact Statement  
Occupancy Agreements**UPDATED ONLINE**Asset Business Plans (ABP) ..... 34  
Building Preservation Plan (BPP) ..... 34  
Level IV W&BER ..... 34  
INCORPORATED INTO THE FEASIBILITY STUDY, PDS, and PMP ..... 35  
Building Commissioning ..... 35  
Superconducting Industry Radiation Studies (IRC) - Based Building Information  
Modeling (BIM) ..... 35  
Hazardous Materials Studies ..... 36  
Security Studies- Progressive Collapse, Blast/Window Vulnerability ..... 36  
Seismic Studies ..... 39**REQUIRED DOCUMENTATION - BORDER STATION NEW CONSTRUCTION** ..... 40Summary of Border Station Required Documentation - TBD ..... 40  
SUBMITTED BY THE REGIONS INTO PIP - TBD ..... 40**REQUIRED DOCUMENTATION - COURTHOUSE NEW CONSTRUCTION** ..... 41Summary of Courthouse New Construction Required Documentation ..... 41  
SUBMITTED BY THE REGIONS INTO THE PIP ..... 42  
Prospectus ..... 42

### PBS OCA 3D-4D-BIM Program

#### FedBizOpps:

For all prospectus projects receiving design funding in **FY2007 and beyond**, a **spatial program** Building Information Model will be the **minimum requirement** for all new and modernization projects that will be submitted to Commissioner of the Public Buildings Service for **Final Concept approvals**.



# Creating a Standard for BIM

- The NBIMS Project Committee seeks to facilitate integration by providing a
  - common **language for describing facility information**
  - common **views of information** based on the needs of businesses engaged in all aspects of facility commerce
  - common **standards for sharing data** between businesses and their data processing applications.
- expected to significantly reduce
  - building costs
  - insurance liability
  - construction schedules
  - operating expense
- expected to significantly increase
  - building performance
  - safety, building life
  - occupant efficiency



# partnering and collaboration

- International standards organizations include the
- National Building Information Model Standard (NBIMS), National Institute of Building Standards (NIBS)
- Open Standards Consortium for Real Estate (OSCRE),
- Open Geospatial Consortium, Inc. (OGC®),
- International Alliance for Interoperability (IAI) International, and
- FIATECH – an industry consortium formed to identify and accelerate the development, demonstration and deployment of fully integrated and automated technologies.
- American Institute of Architects (AIA),
- Building Owners & Managers Association (BOMA),
- Construction Specifications Institute (CSI),
- Construction Users Roundtable (CURT),
- International Facilities Management Association (IFMA),
- Mortgage Bankers Association, etc.



# For information to be useful it must adhere to open standards.

- The beneficiaries of BIM include
  - owners, planners, realtors, appraisers, mortgage bankers, designers, engineers, prototypers, estimators, specifies, safety, occupational health, environmentalists, contractors, lawyers, contract officers, sub-contractors, fabricators, code officials, operators, risk management, renovators, first responders and demolition.
- Each has their own view of the information, many share the same information but some have unique uses.
  - Some supply information,
  - some use information
  - some do both, supply information and use information



# Problem - Building Documentation is Fragmented . . .

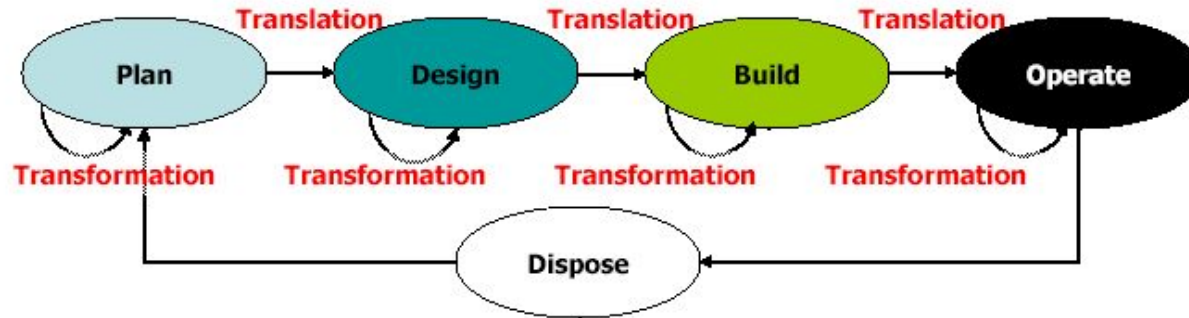
- architects design, constructors construct, and building managers manage in isolation.
- Architects, Engineers and Construction Contractors each submit design plans,
- operating instructions and repair manuals in hardcopy
- which must be organized and maintained in order to support building operations, maintenance and renovation throughout the building's life
- The vision is to reengineer the fragmented building industry to seamlessly integrate all building project phases within a BIM concept.
- Thus, the aim of BIM is to integrate, standardize, and codify best practices within all phases of the building industry.
- The goal is to create an infrastructure to capture, organize and mine that information.





Various documents share same information structures , however, information generated in each document cannot directly be transferred to another application or cross-referenced

## Problem - Critical data is lost ...



- decisions made as ideas & parts are **transformed** into designs & buildings are not captured
- **translation** of information for downstream use loses much of what is known during the previous phase

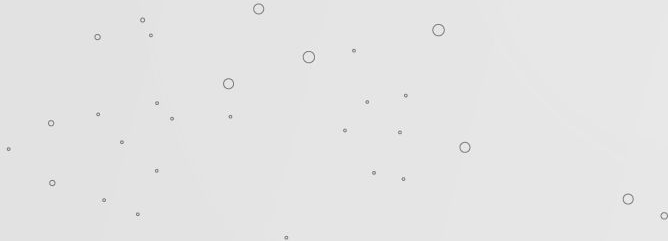
# NIST Study on Cost of Inadequate Interoperability

- 2004 NIST study (U.S. Department of Commerce, National Institute of Standards and Technology, “Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry”. (NIST GCR 04-867, August 2004) estimates that at least \$15.8B is lost annually due to the lack of interoperability.  
<http://www.bfrl.nist.gov/oae/publications/gcrs/04867.pdf>

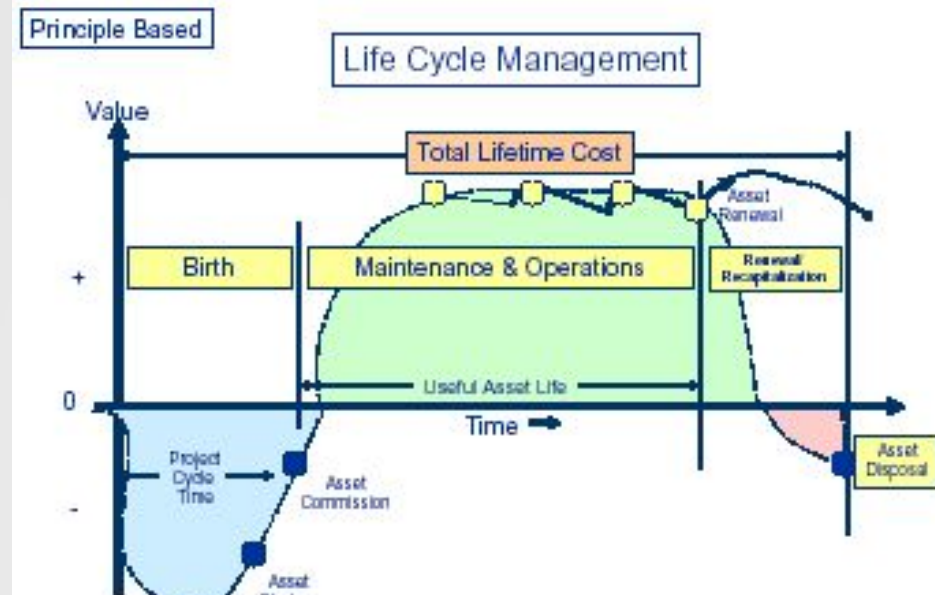


Interoperability is the ability to share and manage information between project stakeholders.

- Currently, BIM is envisioned as an approach to **data integration (interoperability)**, a central repository of continuously available up-to-date integrated information on building design, construction, and management.
- However, for BIM to be effective and replicable, agreement on the concepts must be achieved and codified within suitable computable technologies that are organic and adaptable to changing circumstances.



**BIM is intended to be a open standards based repository of information for the facility owner/operator to use and maintain throughout the life-cycle of a facility.**





# ***Engineering, Construction, and Facilities Asset Management: A Cultural Revolution***





National Institute of  
Building Sciences

**National Building Information Model Standard**

Based on and supporting



**buildingSMART**  
International Alliance for Interoperability

Industry Foundation Classes  
Information Delivery Manuals  
and International Framework for Dictionaries

# ***BIM: Pushing Standards To The Edge***

## ***National Building Information Model Standard***

Deke Smith, RA

Chair, NIBS National BIM Standard Project Committee

---

Federal Facilities Council

October 31, 2006

This presentation is a collaborative product of the NIBS NBIMS Project Committee.

***National Building Information Model Standard***

© NIBS 2006

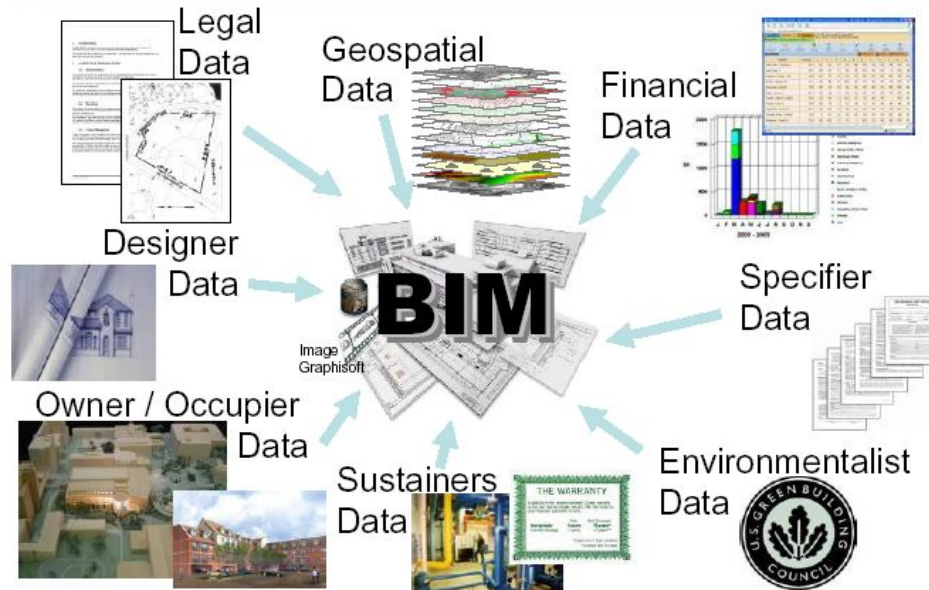


## Define expansive scope of BIM

- Everyone starting from different points of view
- Breaking down stovepipes
- Developing awareness and appreciation of life-cycle approach



### BIM's Business Data Types



National Building Information Model Standard





## BIM Enabled Construction Industry



### HAZARDOUS MATERIAL IDENTIFICATION GUIDE

HAZARD	REACTIVITY	PROTECTIVE EQUIPMENT	HAZARD	REACTIVITY	PROTECTIVE EQUIPMENT
1. Explosive	2. Flammable	3. Corrosive	4. Toxic	5. Irritant	6. Harmful
7. Radioactive	8. Inert	9. Non-hazardous	10. Non-hazardous	11. Non-hazardous	12. Non-hazardous
13. Non-hazardous	14. Non-hazardous	15. Non-hazardous	16. Non-hazardous	17. Non-hazardous	18. Non-hazardous
19. Non-hazardous	20. Non-hazardous	21. Non-hazardous	22. Non-hazardous	23. Non-hazardous	24. Non-hazardous
25. Non-hazardous	26. Non-hazardous	27. Non-hazardous	28. Non-hazardous	29. Non-hazardous	30. Non-hazardous

# BIM

Graphisoft



### Facility Information Views

- Owners
- Planners
- Realtors
- Appraisers
- Mortgage Bankers
- Designers
- Engineers
- Cost & Quantity Estimators
- Specifiers
- Contracts & Lawyers
- Construction Contractors
- Sub-Contractors
- Fabricators
- Code Officials
- Facility Managers
- Maintenance & Sustainment
- Renovation & Restoration
- Disposal & Recycling
- Scoping, Testing, Simulation
- Safety & Occupational Health
- Environmental & NEPA
- Plant Operations
- Energy, LEED
- Space & Security
- Network Managers
- CIO's
- Risk Management
- Occupant Support
- First Responders

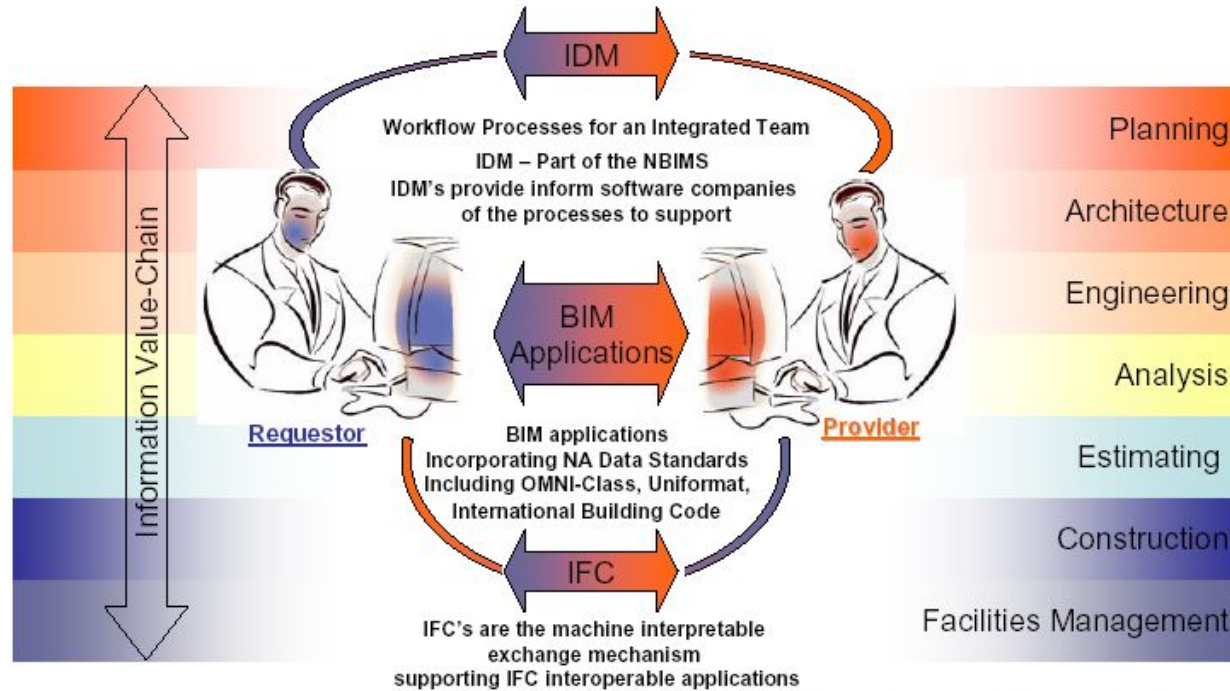
National Building Information Model Standard







## Developing the BIM Value-Chain



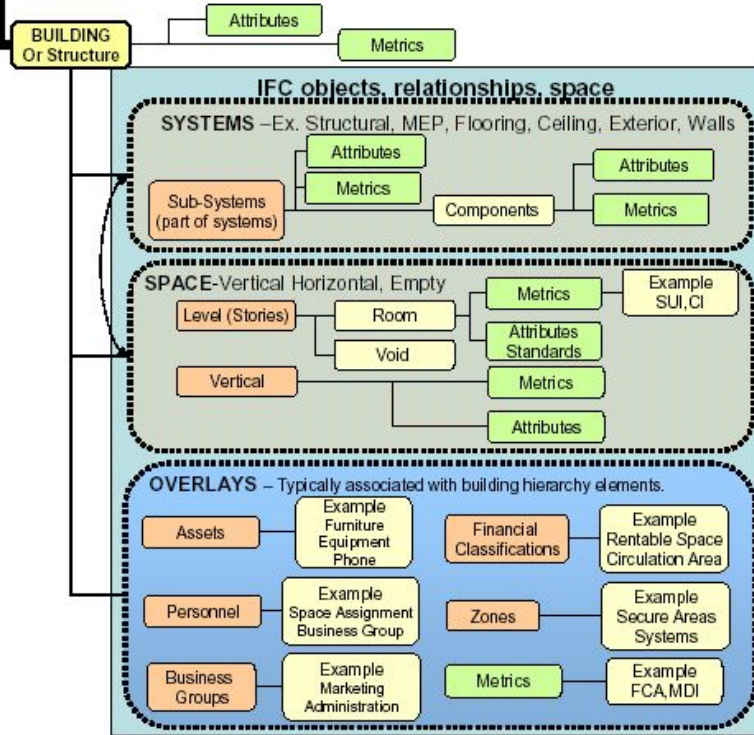
*National Building Information Model Standard*







## Hierarchical Building Information Relationships

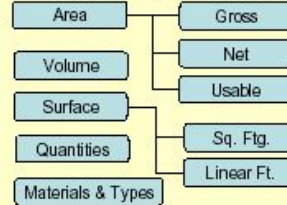


**Systems** represent the physical entities of the building. Systems use NA classifications such as Omni-Class and Unifomat and are transported/exchanged via IFCs

**Space** is physical in nature, but can be unbounded (have no or cross physical boundaries) but it will always be tied to the physical structure or systems in some way

**Overlays** are more abstract data - organizational, operational, functional, financial, non-fixed assets, resources, personnel, etc. that is data tied to the Systems and Space

### Reports or Extracted Data from BIM (examples from all classifications)



Building Information Model Standard



# buildingSMART

International Alliance for Interoperability

- Patrick MacLeamy, FAIA
- CEO, HOK
- International Chairman, IAI



buildingSMART organization



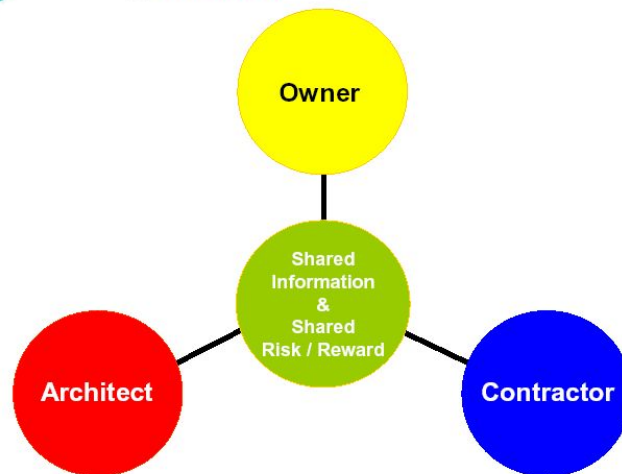
buildingSMART design



buildingSMART information exchange



## buildingSMART Organization

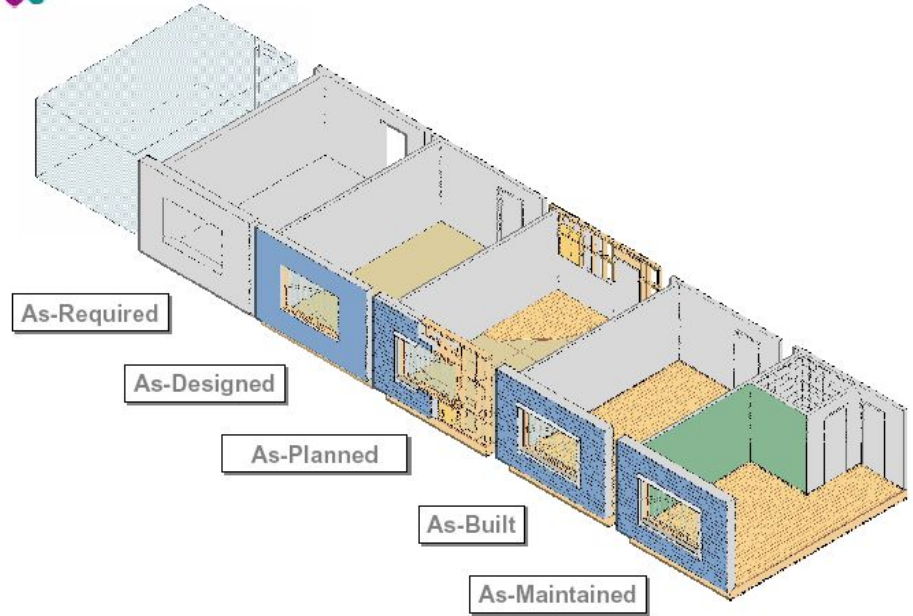


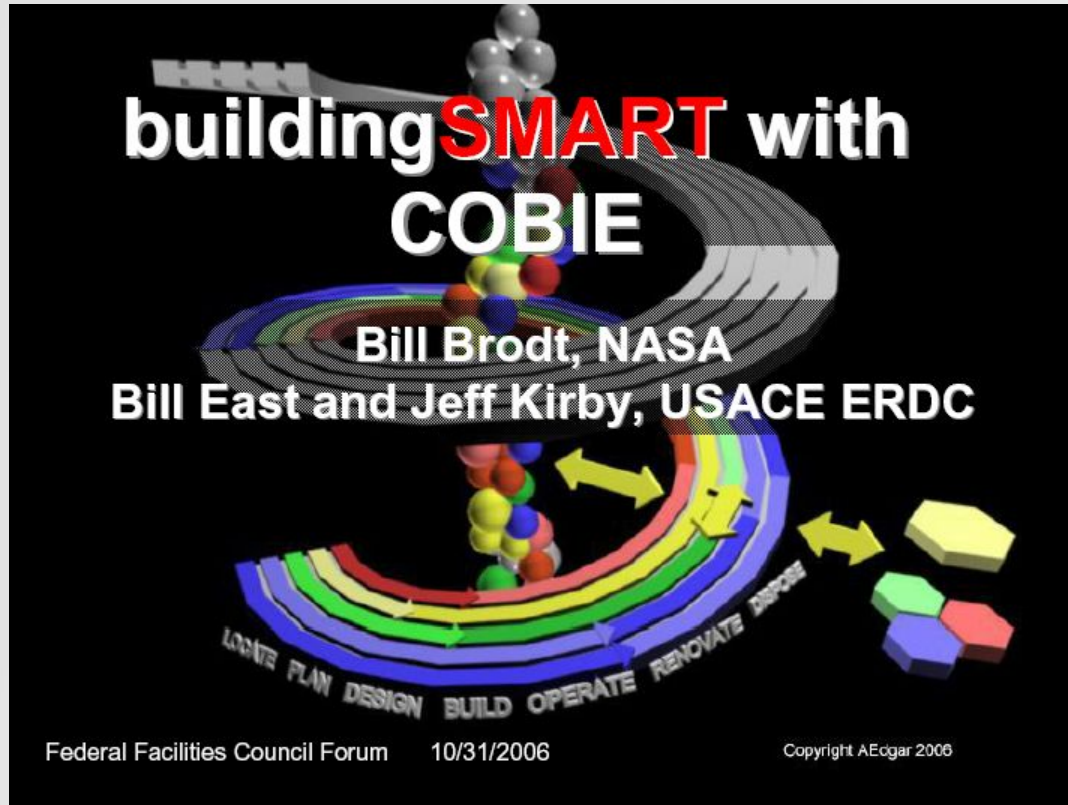


## IAI Mission

- Promote efficiency in the building industry
- Support open standards for information exchange
- Encourage buildingSMART adoption worldwide
- Develop a universal translator (IFCs)

## buildingSMART – IFC Versions

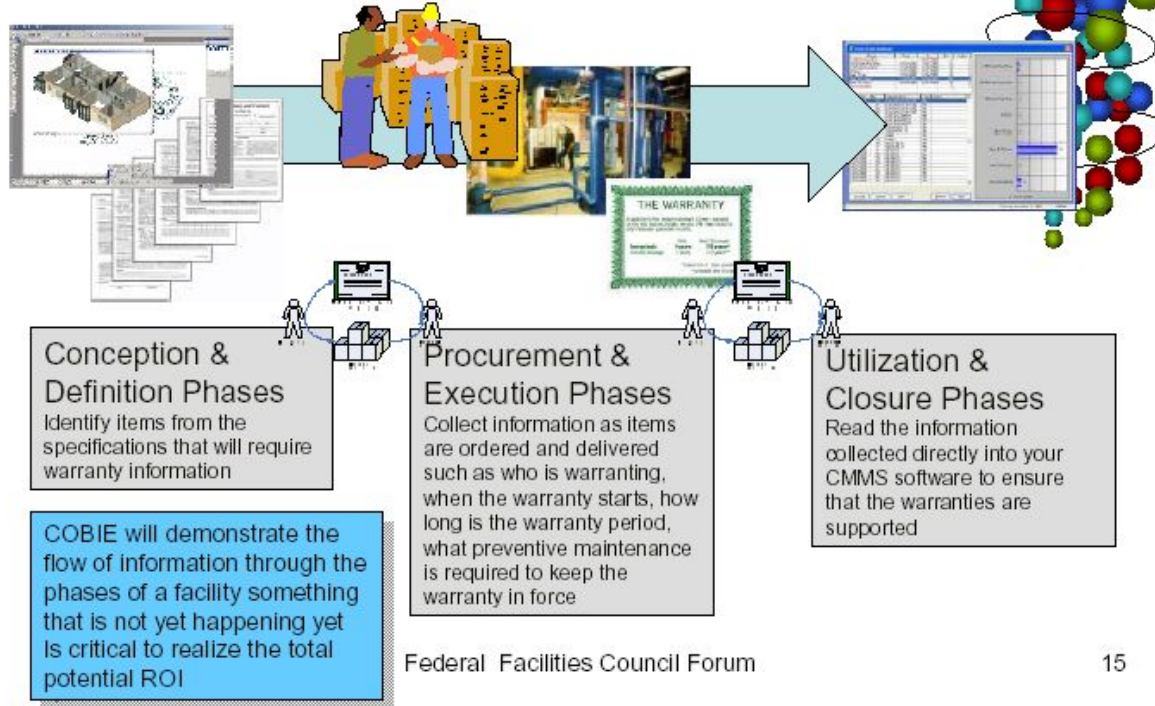




COBIE Overview Briefing:

[http://nbims.opengeospatial.org/files/?artifact\\_id=352](http://nbims.opengeospatial.org/files/?artifact_id=352)

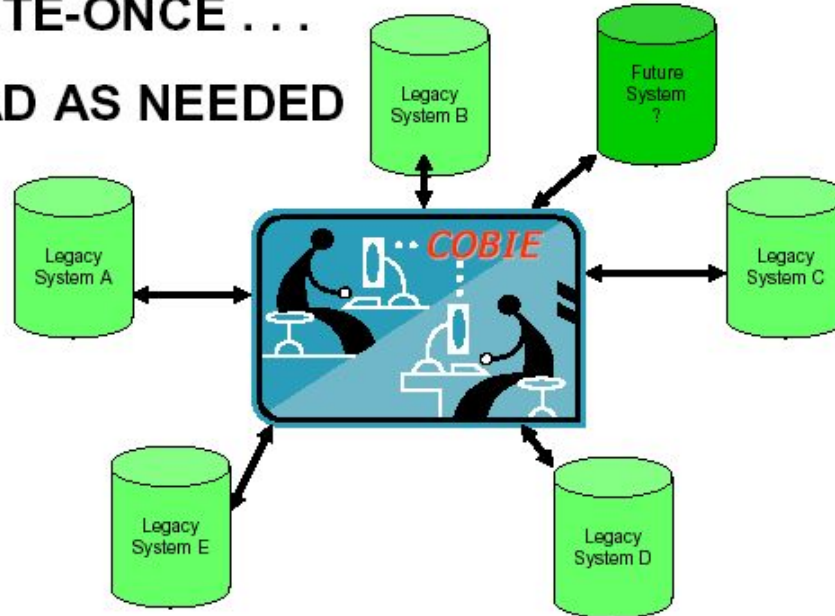
# COBIE Construction Operations Building Information Exchange



**COBIE** uses internationally recognized  
standard and data definitions requirements . . .

**WRITE-ONCE . . .**

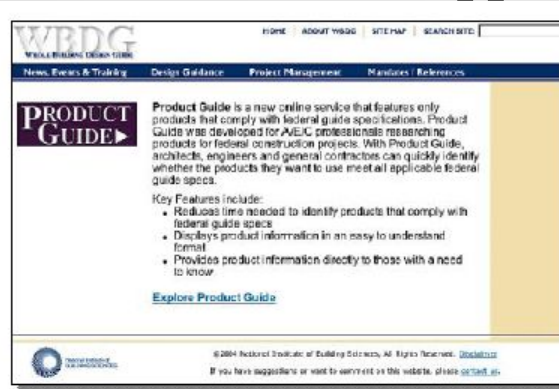

**READ AS NEEDED**





# Captures Information at Source

## Designers, Constructors &



**PRODUCT GUIDE**

Product Guide is a new online service that features only products that comply with federal guide specifications. Product Guide was developed for A/E/C professionals researching products for federal construction projects. With Product Guide, architects, engineers and general contractors can quickly identify whether the products they want to use meet applicable federal guide specs.


Key Features include:

- Reduces time needed to identify products that comply with federal guide specs
- Displays product information in an easy-to-understand format
- Provides product information directly to those with a need to know

[Explore Product Guide](#)

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**Product Data Sheet**

**FOAMULAR® 44 & 64**  
FOAMULAR  
44/64 F  
XPS  
Rigid Insulation

**Product Description**

FOAMULAR 44 & 64 is a rigid, closed-cell polystyrene insulation. It is available in two densities: 44 lb/ft³ (1780 kg/m³) and 64 lb/ft³ (1600 kg/m³). It is used for exterior wall insulation, roof insulation, and floor insulation.

**Physical Properties**

Property	44 lb/ft³	64 lb/ft³
Density	44 lb/ft³	64 lb/ft³
Compressive Strength	150 psi	250 psi
Tensile Strength	100 psi	150 psi
Modulus of Elasticity	1.5 x 10⁶ psi	2.0 x 10⁶ psi

**Thermal Properties**

Property	44 lb/ft³	64 lb/ft³
Thermal Conductivity (k)	0.028	0.025
Thermal Resistance (R)	3.6	4.0

**Chemical Properties**

FOAMULAR 44 & 64 is resistant to most acids, alkalis, and solvents. It is also resistant to mold and mildew.

**Installation**

FOAMULAR 44 & 64 should be installed in accordance with the manufacturer's instructions. It should be protected from moisture during installation.

### Technical Data

- PDF format
- link to URL
- or XML database

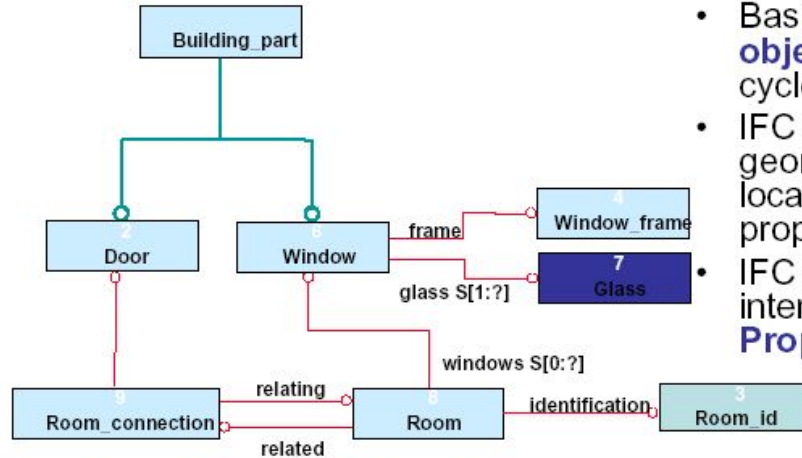
# The IAI IFCs (Industry Foundation Classes)

## model-based standards

- The classes defined by the IAI are termed Industry Foundation Classes (IFCs) for the following reasons:
- IFCs are defined by the AEC/FM **industry**. These specifications represent a data structure supporting an electronic project model useful in sharing data across applications.
- They provide a **foundation** for the shared project model
- They specify **classes** of things in an agreed-upon manner that enables the development of a common language for construction.
  - specify how "things" that could occur in a constructed facility should be represented electronically.
  - The word "class" describes a range of things with common characteristics. For instance, every door has the characteristics of opening to allow entry to a space
    - Class describes real things such as doors, walls, and fans as well as abstract concepts such as space, organization, information exchange, and process).
    - Class can also describe abstract concepts such as space, organization, information exchange, and process.



# Industry Foundation Classes



- Set of internationally standardized **construction industry object definitions**
- Basis – **integration of objects** across project life cycle using a single model
- IFC stores **object data** – geometry, 3D dimensions, location, relationships, properties
- IFC and *OmniClass* intersect in **Elements** and **Properties Table**

International Open Standard = IFC model



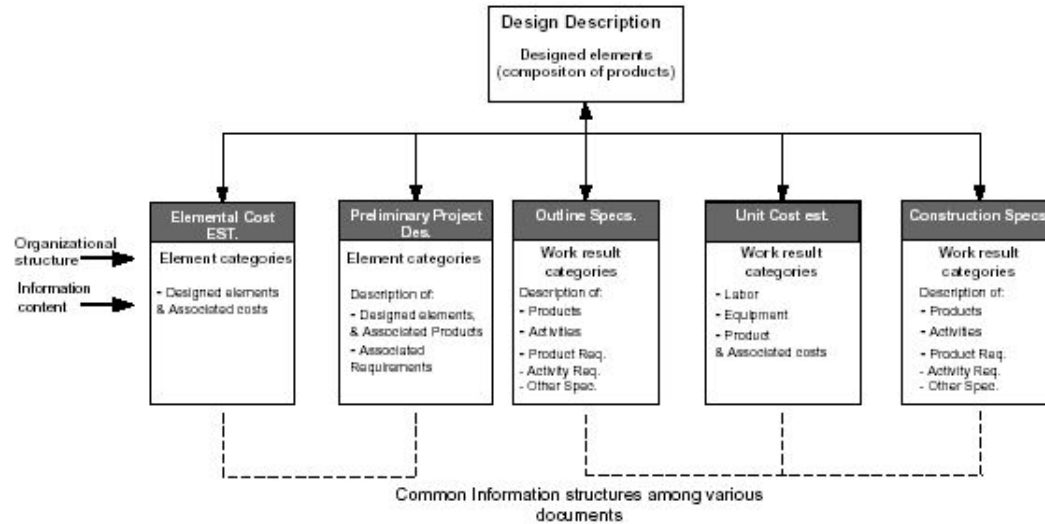
The Construction  
Specifications Institute

October 2006

13



# CSI Formats and Building Information Modeling

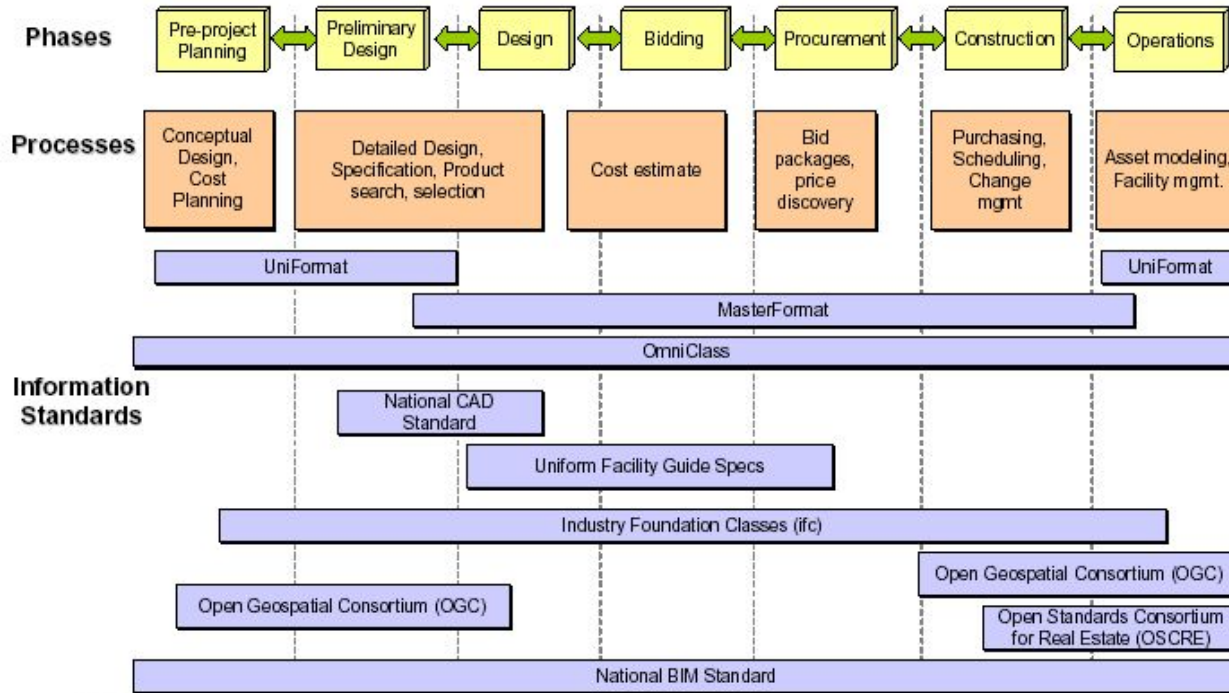


**Roger J Grant**  
Director Technical Services and Development,  
The Construction Specifications Institute

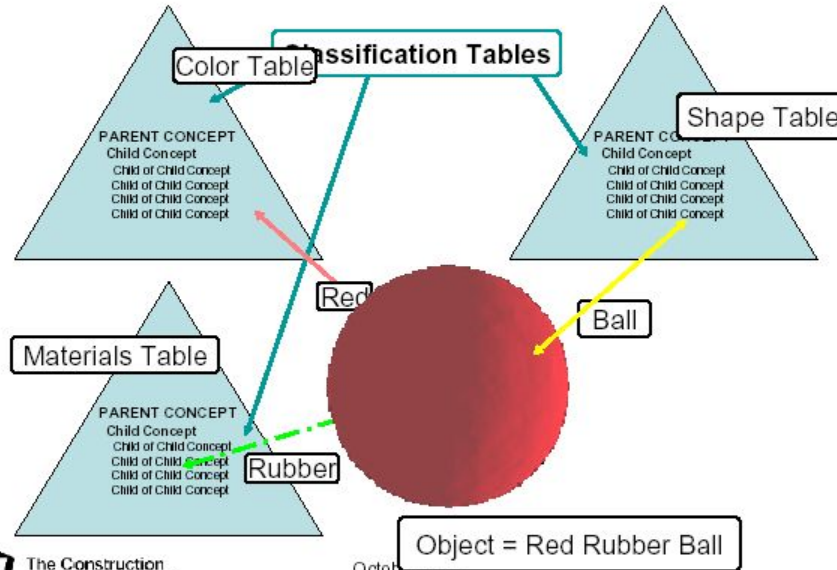




# North American Information Standards

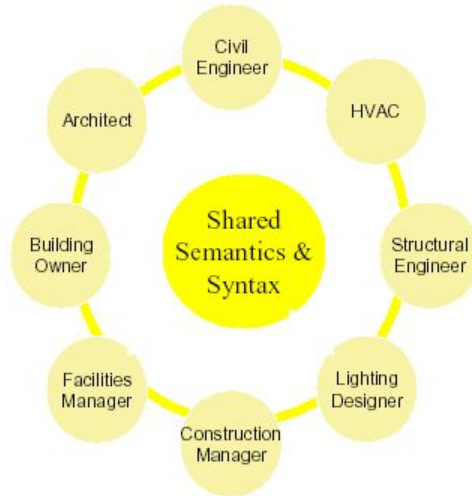


# Faceted Classification



# Bi-directional Information Flow and Cross-referencing

## Agree on Semantics and Syntax



- *Participants can communicate using a common language*
- *Any participant can communicate with any other participant*
- *Facilitates high performance teams*



# Info-Centric Organization

## Framework for Integrated Decision-Making

Essence of this IT-Enabled Enterprise Framework:

- Moving away from building-centric and project focus
- Moving to a portfolio-based, business process linked to strategic outcomes
- Continuous horizontal flow across the organization
- Break down of the traditional structure of professional and trade disciplines and traditional stove piped software development
- IAI-IFCs and IFGs important because they enable the horizontal process flow through an open architecture and international standards







## Capital Asset Management Portal

Access to Aggregated Database and Graphics

CAMP combines and displays portal tools and data views supporting Portfolio Management and Integrated Decision-Making and Value Chain.

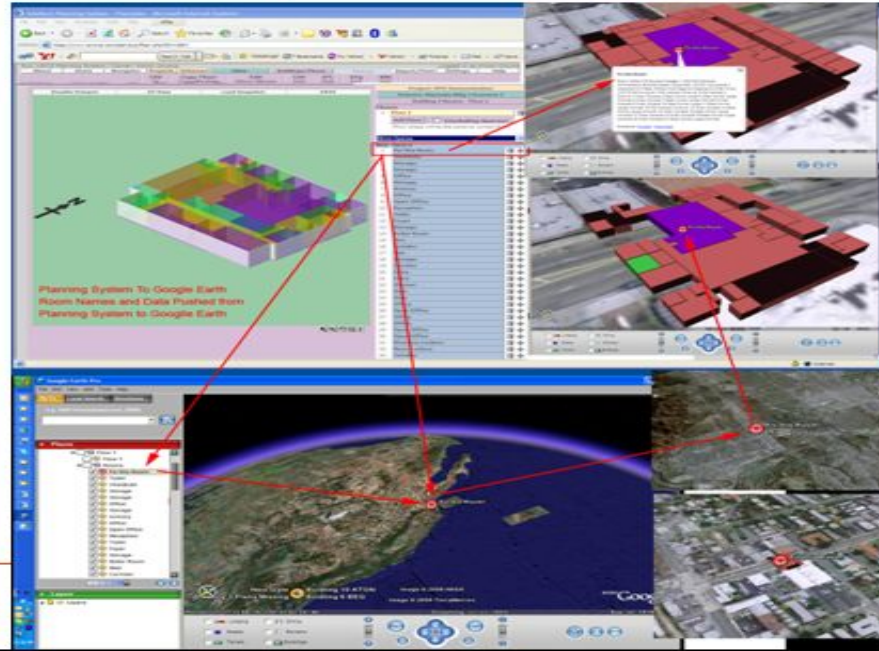
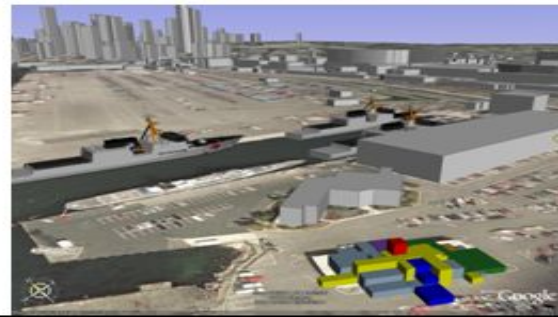
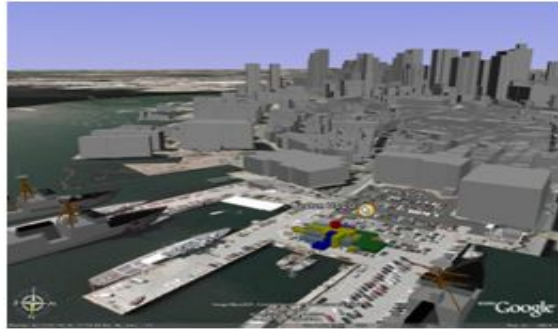
- Portfolio Management Links Supply and Demand Side of Scenario Based Mission Planning:
- Real Time Mission Readiness
- Scenario Based Business Case Development
- Automated Planning Documentation and Web-enabled Approval Process
- Value Chain as Web-enabled Workflow





# Combined BIM and GIS Workflows

## Multiple Data Sources Accessed through CAMP





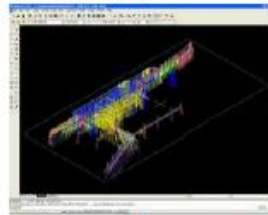
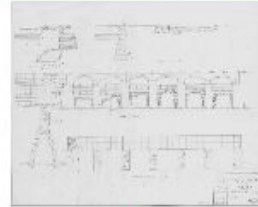
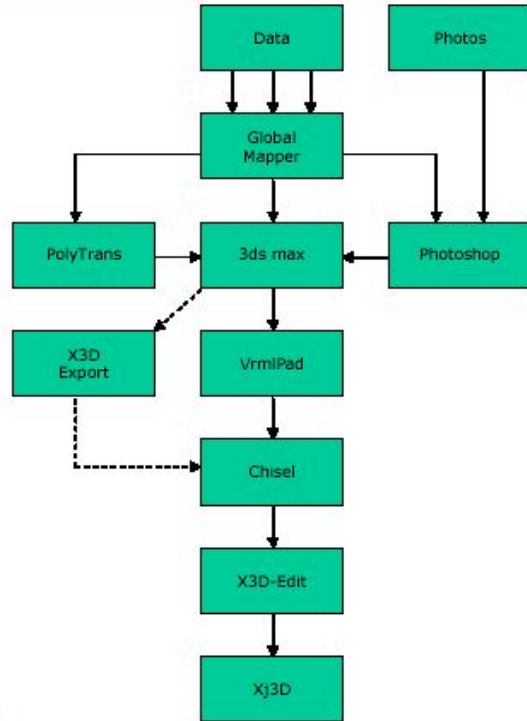
Alex Viana

Naval Facilities Engineering Command

Washington Navy Yard, DC

- This presentation describes a step by step processes utilized to produce virtual 3D waterfront facility models of the Navy's built environment from paper drawings, existing 2D CAD files, and other geospatial data sets. The facility models have been created in open source, ISO-based standards format for 3D web graphics.

# 3D Model Production Process







# Virtual Earth Viewer for Navy Waterfront Facilities

**VIEWPOINTS**

- MSF Overview
- JAGG P1
- JAGG P2
- Yokosuka P1
- Yokosuka P2
- Hr. 2000

**Magnetometer Support Device (MSD)**

Configuration from MS

[Data Upload](#)

[Project Completion Report](#)

**Design Details**

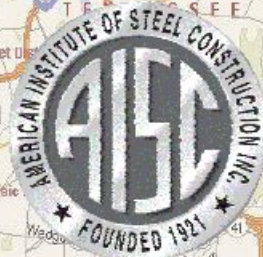
**Vendor Information**

**Inspection Reports**



# THE ROAD TO PRODUCTIVITY

Lessons Learned by the Structural Steel Industry



Tom Faraone, PE  
Senior Regional Engineer  
October 31, 2006



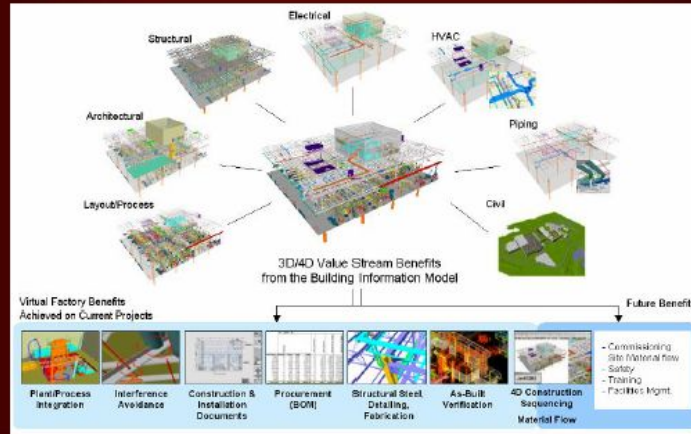


12 man-hours/ton

oadmap

M Roadmap

# And then came BIM...



Lessons Learned from the Structural Steel Industry

TODAY



Today .5 man-hours/ton

1/3 the energy



# Wayne L Morse U.S. Courthouse Eugene, OR



"Fastest GSA project ever."  
"Change orders were less than 3%."

**Lessons Learned from the Structural Steel Industry**



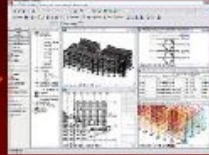


## A BIM Roadmap

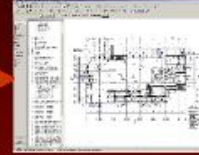
### ARCHITECTURAL



### STRUCTURAL



### HVAC



### CLADDING



IFC

IFC

IFC

### INCREASED PRODUCTIVITY EQUALS

Greater Value

Lower Costs

Accelerated Schedules

Safer Construction

Building Information Modeling horizontally integrates all building systems into a single, consistent design model allowing coordination of components and elimination of interferences.

Lessons Learned from the Structural Steel Industry

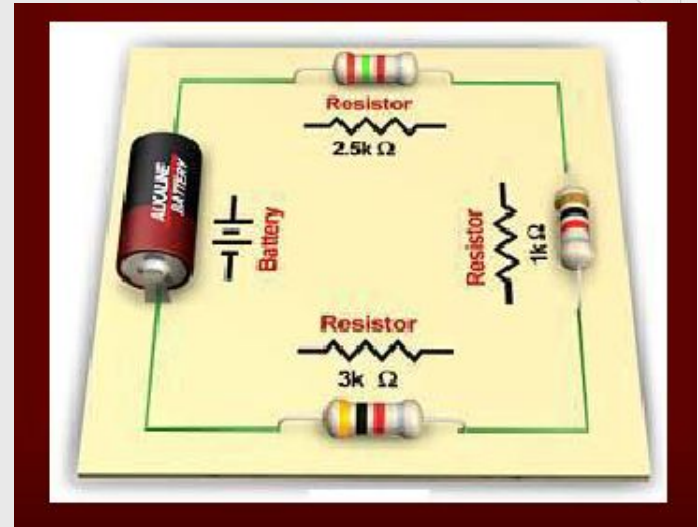
BIM is merely an enabler

it may institutionalize process changes,  
it does not drive change;

People propel organizational changes (Spitzer, 1996).

Institutional barriers and inertia yield slowly to data sharing and system interoperability initiatives, even when it is obvious that data sharing and interoperability will save time, money and lives.

**RESISTANCES:**



# Coordination among standards organizations

## interoperability between geospatial and BIM environments

- The CAD-GIS Interoperability Working Group in the Open Geospatial Consortium, Inc. (OGC(R)) OGC Web Services Interoperability Initiative (OWS-4), which begins in April, 2006
- International Alliance for Interoperability (IAI) advancing BIM work based on the Industry Foundation Class (IFC) standard, and eXtensible Markup Language (XML) and XML-based GML expressions of IFC are being developed to improve the integration of geospatial as well as architecture, engineering, construction and facilities management (A/E/C/FM) information in a single model.
- The Open Standards Consortium for Real Estate (OSCRE) ([www.oscre.org](http://www.oscre.org)), a widely recognized e-commerce standards group working within the real estate industry. OSCRE works closely with an international organization, the Property Information Systems Common Exchange Standard (PISCES). The OSCRE standard enables the electronic transfer of real property information directly from one system into another, reducing or eliminating the need to send hardcopy and re-enter data manually.
- FIATECH ([www.fiatech.org](http://www.fiatech.org)), a non-profit consortium focused on fast-track development and deployment of technologies to improve how capital projects and facilities are designed, engineered, built and maintained.
- OGC also has a formal collaborative agreement with the U.S. National Institute of Building Sciences (NIBS), which administers IAI for North America. Discussions with other IAI chapters are underway.



# Emerging Technology Summit

## ETS - IV: Convergence: CAD / GIS / 3D / BIM

Start: 2007-03-21 08:00 End: 2007-03-23 17:00

- Details: Presented by the Open Geospatial Consortium and the Geospatial Information & Technology Association
- This ETS will focus on those standards and the benefits of Building Information Models (BIM), including:
  - \* Designers and engineers will have lower costs and risks
  - \* First responders will be able to respond more quickly
  - \* Efficient monitoring will lower operating costs
  - \* Better views of facilities will lead to better decisions
  - \* Realtors, appraisers, and bankers will save money
  - \* Regulations compliance costs will be lower
  - \* Subcontractors' costs and risks will be reduced
- This Emerging Technology Summit and Workshop will be held at the Melrose Hotel
- Melrose Hotel  
2430 Pennsylvania Avenue, NW  
Washington, DC 20037  
Tel: 202 955 6400
- [Driving Directions and Map](#)
- Check back soon for more details and online registration!





# Elements of the Project Charter

- Spatial awareness across AEC lifecycle is defined to be critical requirement
  - Inside and outside of a building
- Identify and define requirements where convergence between geospatial and building information across the building lifecycle is needed
- Review and where possible adapt geospatial standards-based workflows that meet requirements, save time and effort where convergence exists
- Identify existing standards that are ready for immediate testing for candidate status



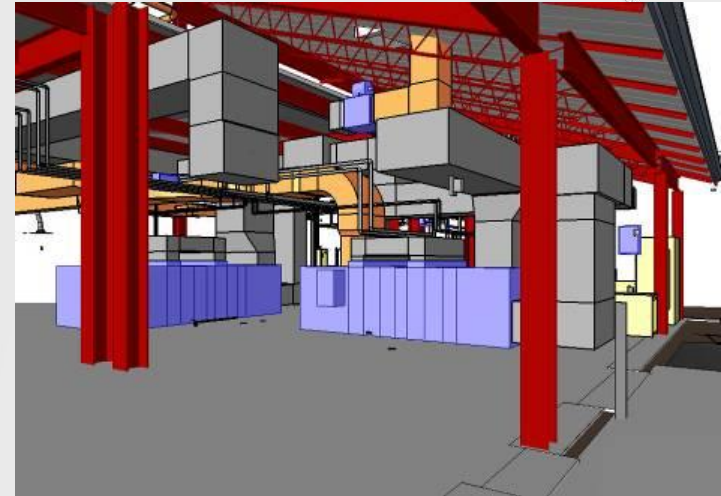
# BIM-GIS Project Focus

- How can BIM applications and information seamlessly interact with geospatial information during across the lifecycle process to address requirements related to site conditions and surroundings?
- How can BIM and geospatial applications be used to communicate campus-wide information requirements for lifecycle facility management and operations?
- How can 3-D CAD and geospatial portrayal services facilitate modeling in campus-wide and facility perspectives for as-is BIM model and further extension for planning or design activities?



# BIM to GIS Integration Issues

- BIM is MUCH richer in detail than a GIS database
- GIS has only recently become fully 3-D
- Design BIM contains all the information needed to construct a building, but not to manage it
  - Space polygons
  - Occupant information
  - Asset details (make, model, etc.)
  - Equipment maintenance data
- Some of the missing data can be supplied by COBie
- GIS database and BIM will require network capabilities to share information



# Fundamental Differences Between BIM and GIS

## BIM (IFC)

- Highly standardized structure
- Parametric – highly structured
- File based
- File based exchange
- Inferior data exchange between COTS products
- Small number of users
- Thick client

## GIS

- User defined structures
- Parametric – loosely structured
- Server based - relational database
- File and web services for exchange
- Maximum integration flexibility
- Large numbers of users
- Thick and thin clients

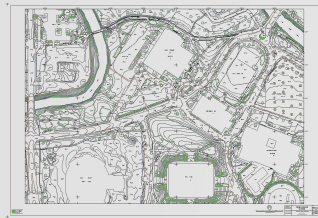




# Potential Integrated CADD/BIM/GIS Data Workflow



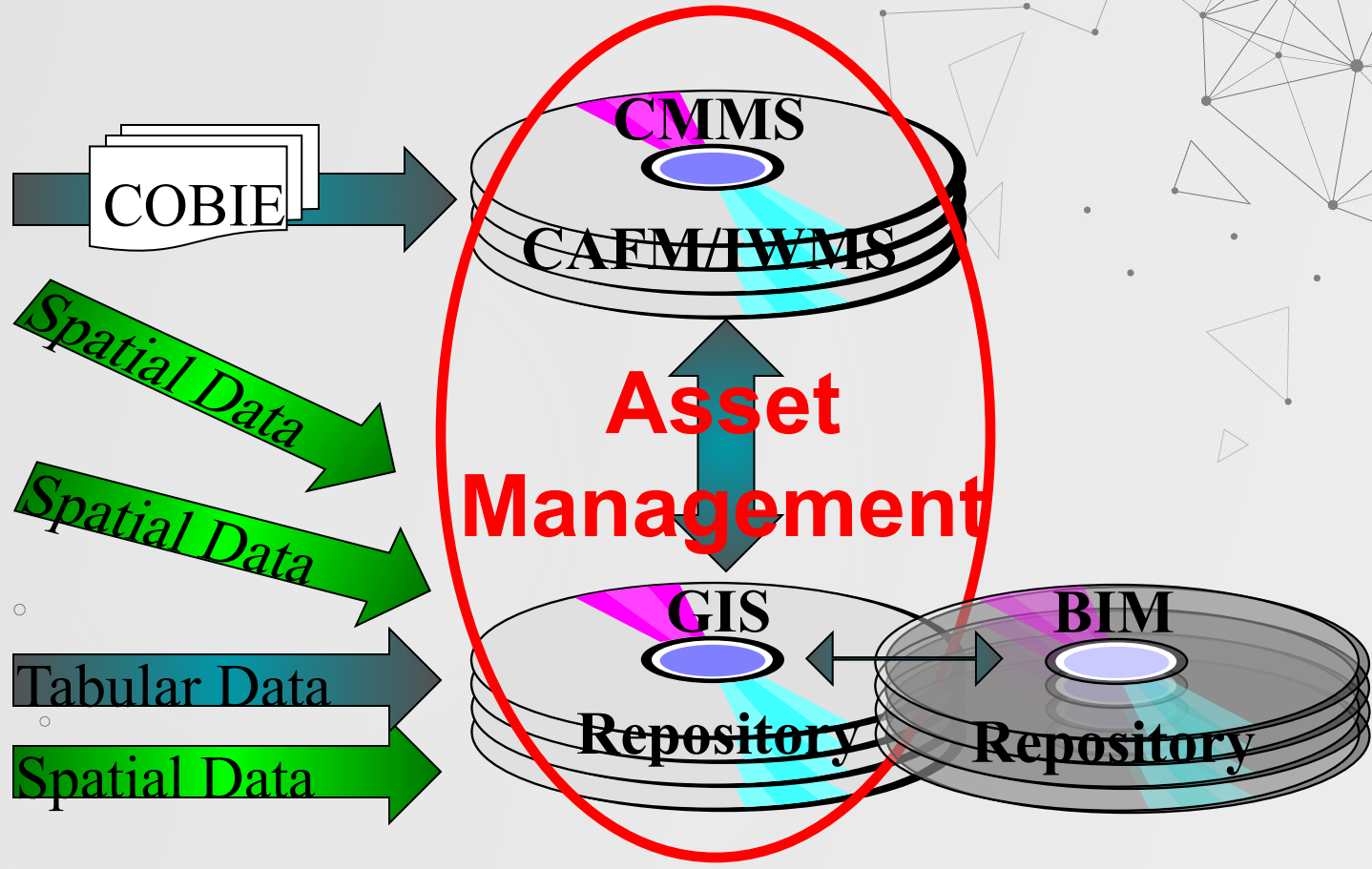
BIM Data



CADD Data

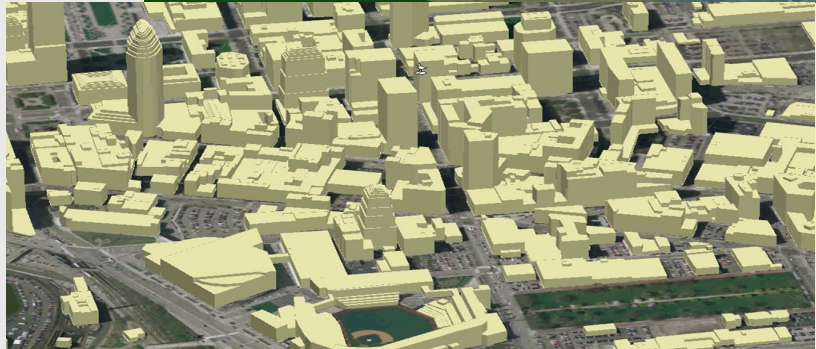
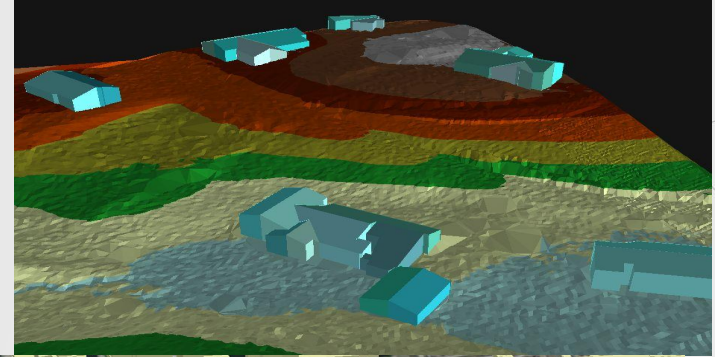
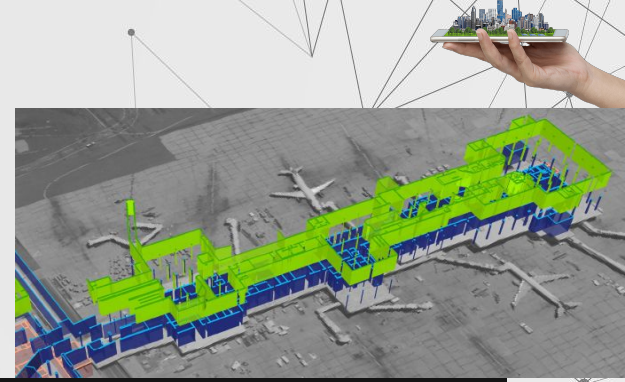


GIS Data



# BIM – GIS Information Exchange Project

- BIM and GIS both play key roles in a facility lifecycle
- Both systems need to exchange data yet both serve as the repository for key data elements
- This Project will provide the basis for an information relationship between the two environments and their underlying databases



# Urban design to Architecture



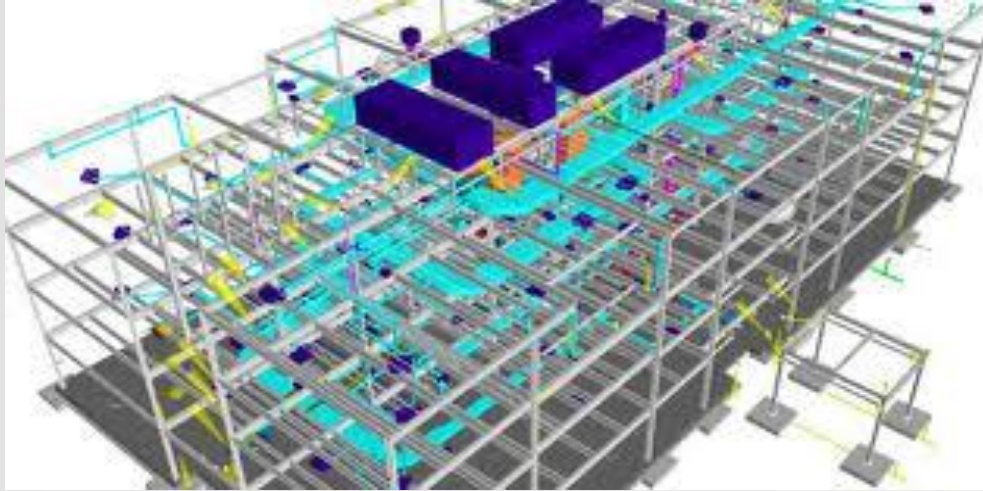


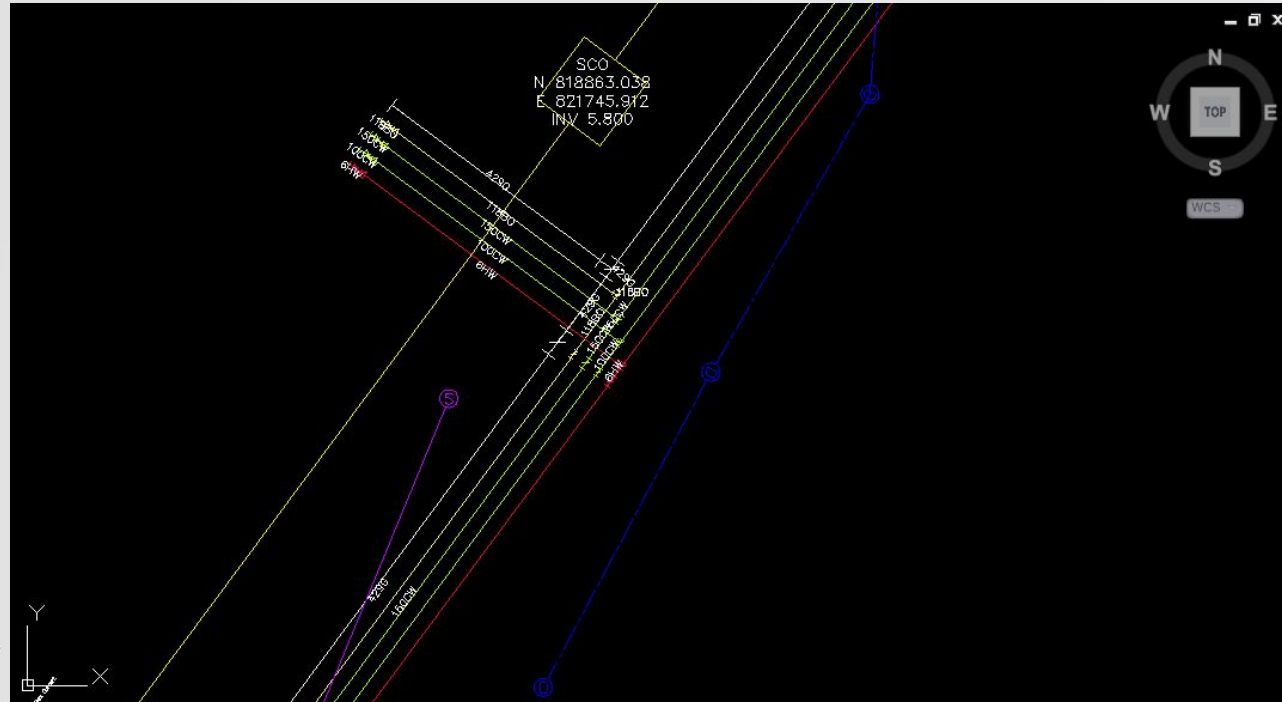
# Engineering Schemes (simplified)



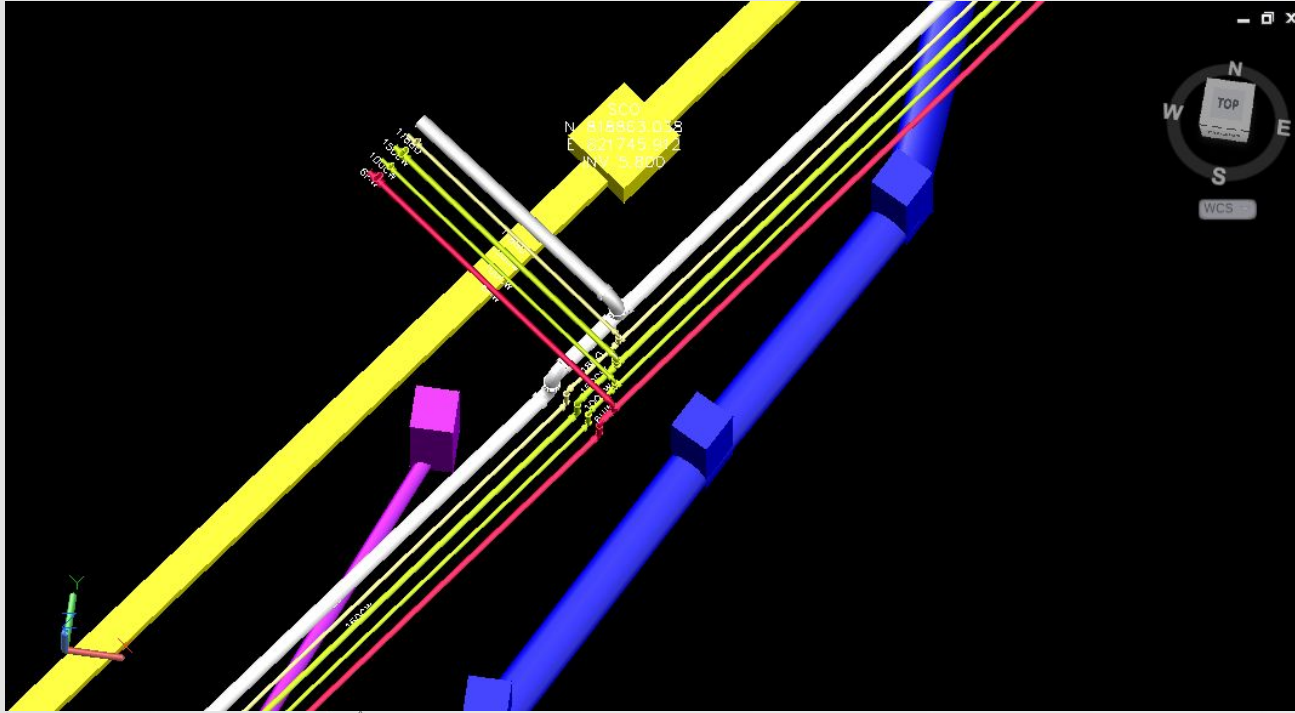


# Construction

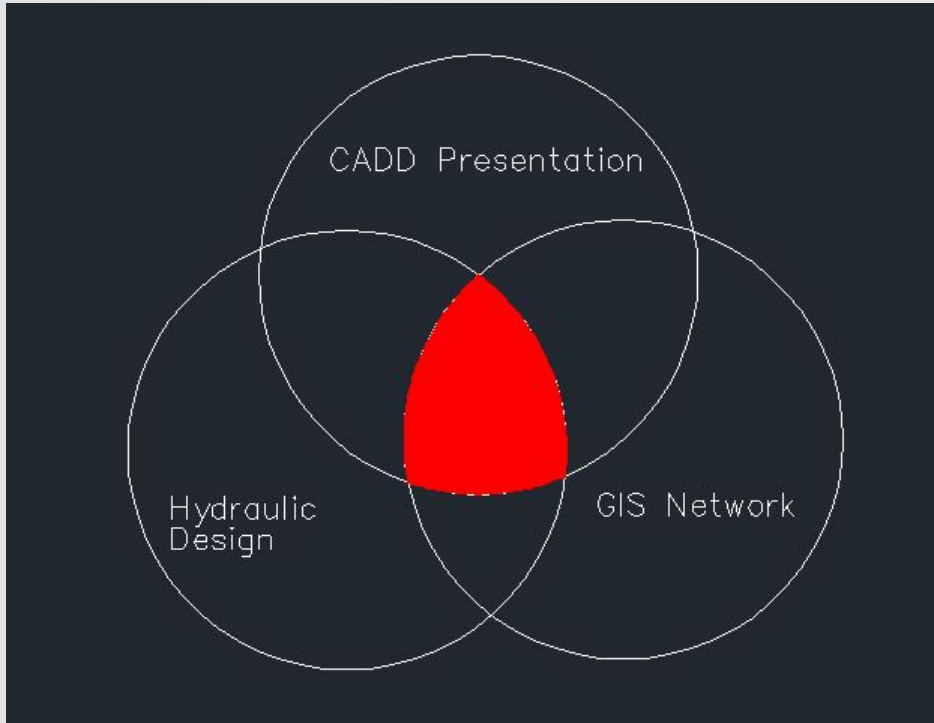




# Underground Utilities - 3D View



# One Drainage Network Model for All



Lollipop Model by C K Ng, 1998



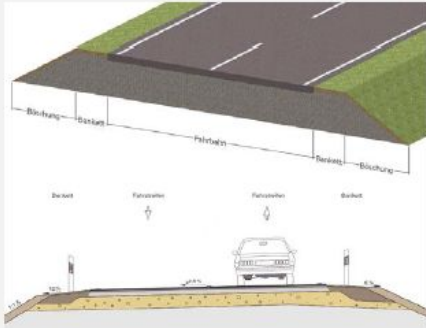


# Station/Process Plant



# Road/Bridge

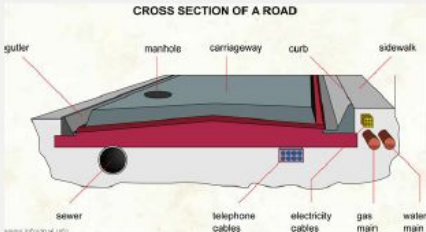
## Infrastructure Scope between GIS and BIM Standards – 2



Road Construction Sectioning



Road Construction - Bridges



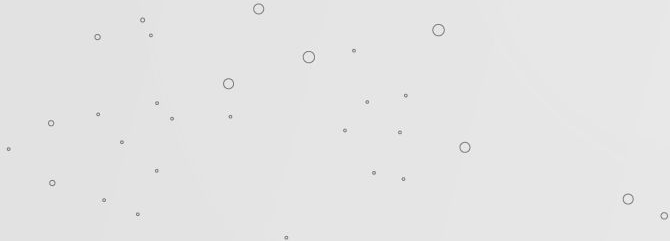
Road Construction Detailing

clearly BIM scope

- big scale
  - engineering CRS
  - mainly volumetric
  - longitudinal structure
  - element composition
- 
- open – bSI / TC59 ?
  - open – IFC ?

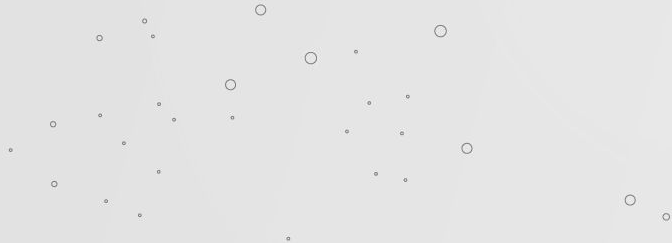
# Key points of non coordinations

- At urban planning stage, site plans are created with very less emphasis on ground level accuracy.
- At Detailed engineering level, there will be need to precise survey of the site, where the plans created in the previous stage are no more useful.
- At the construction stage inputs from earlier stages are not carried in, due to lack of unified coordination.
- In most cases, spatial data is transferred as files ( shape, dwg etc) to the next level.



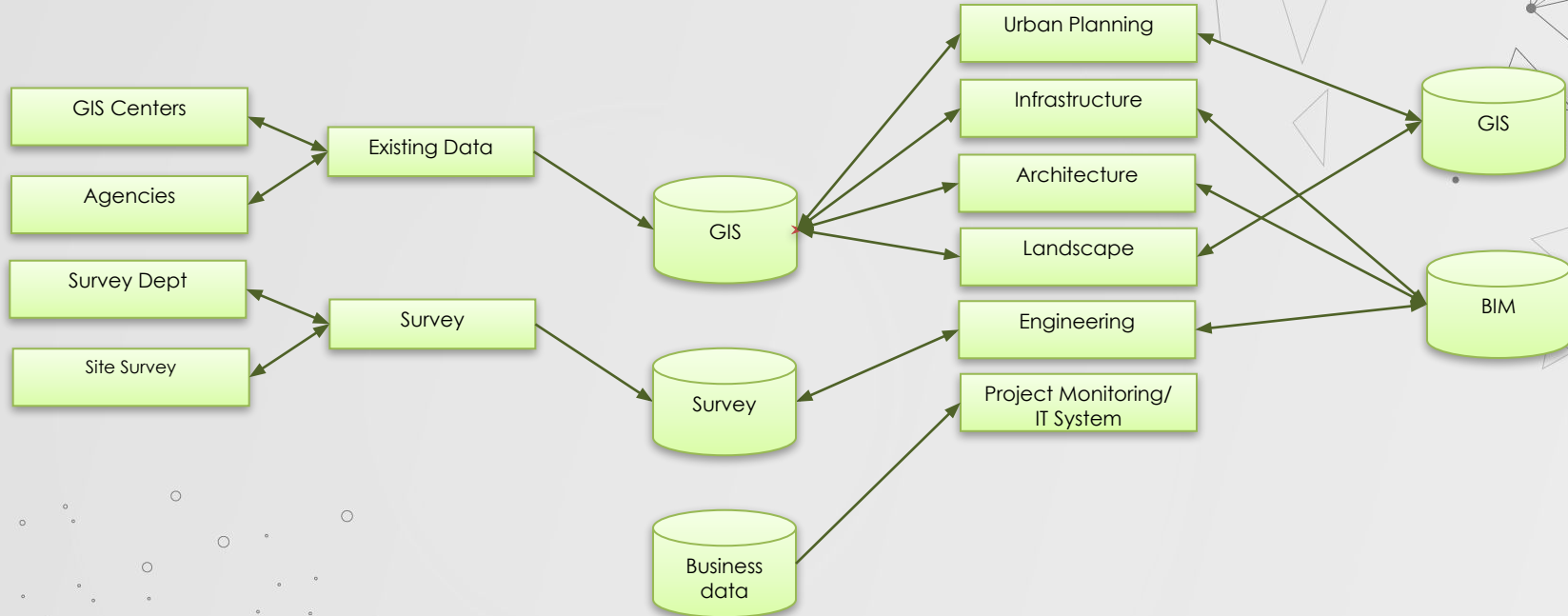
# Reasons

- Isolated business goals and targets.
- Lack of understanding of others businesses.
- Little understanding of the coordination perspective of technologies ( using technology as coordination tool)
- When to do what ( when to bring in technology)





# Result - Silos model



# Business Model for Integration

- Technologists and business leaders are forced to change and bring in better methods to survive in the business and be competitive.
- Michael E porters five competitive forces theory simplifies the reasons for organisations to be nimble.



# Stake holders & roles

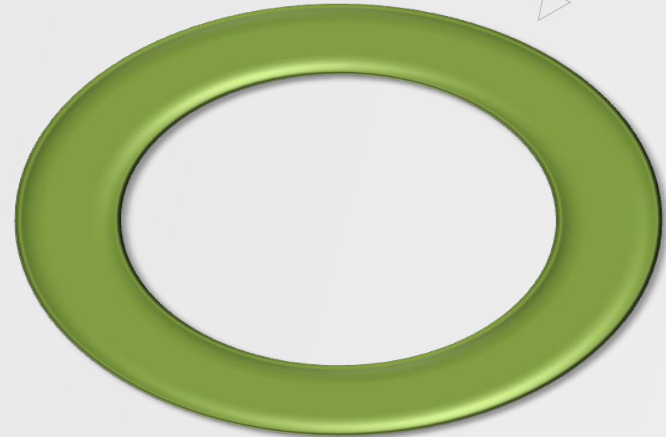
- Technology and domain experts should work together to evolve a solution.
- Design standards and data standards needs to be in place.
- A seamless data models ( simple to complex) needs to be developed.



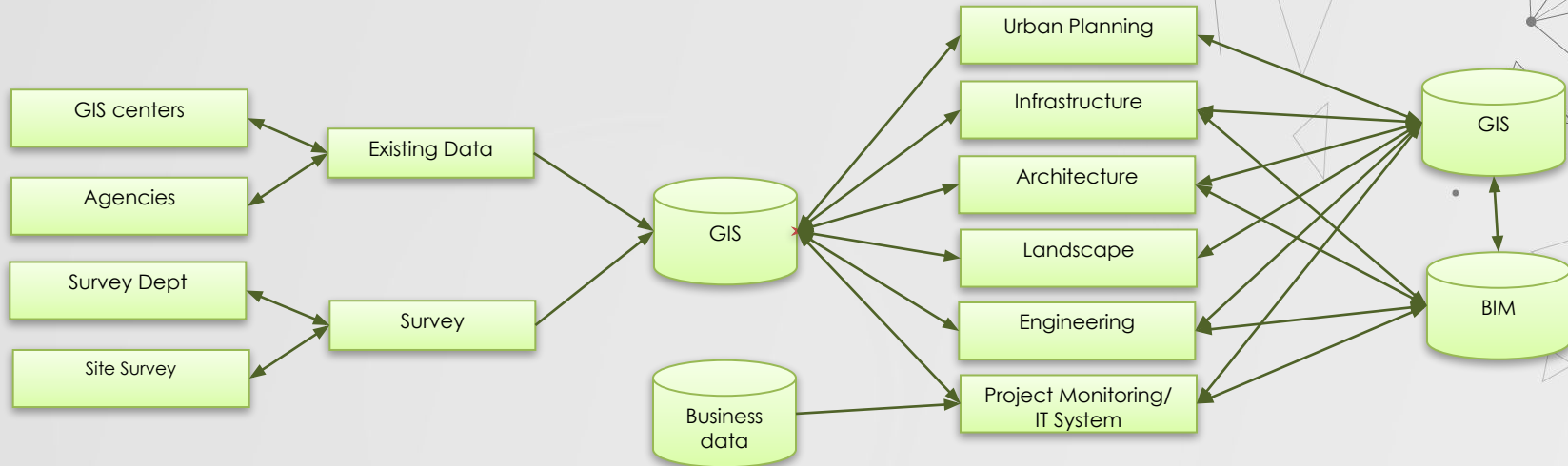
**Leaders**

**Domain Experts**

**Technologists**



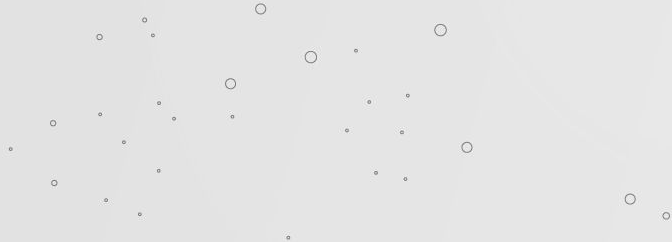
# Integrated model





# Key Technology changes

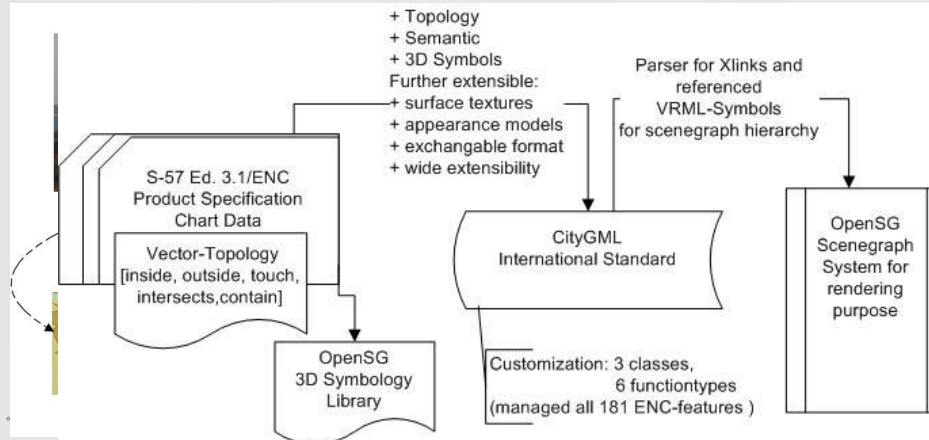
- Real time design and modeling – 3D GIS & BIM
- Unified data models - CityGML
- Intelligent data collection – scanners, sensors
- Extensive knowledge and analytics - GioBI



# CityGML and AR

## search for "augmented reality" citygml

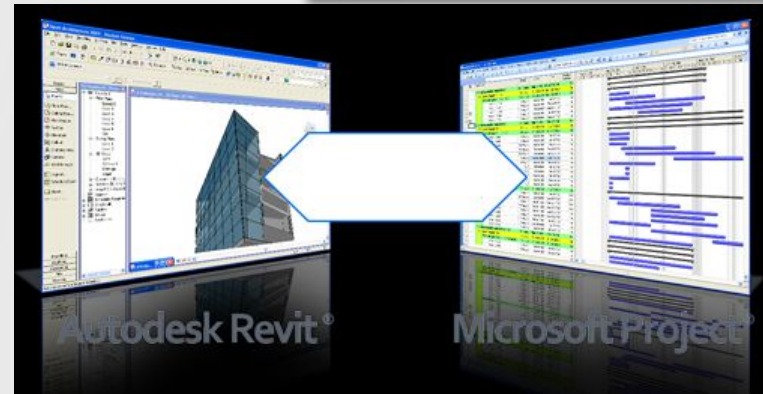
- CityGML
  - Application scheme of GML
  - Structure for thematic modeling, semantic descriptions, appearance storage of 3D geometries and features
  - Aligned with IFCs and BIM standards
- Example: Extension of Electronic Nautical Charts for 3D interactive Visualization via CityGML. Haase and Koch, 2010



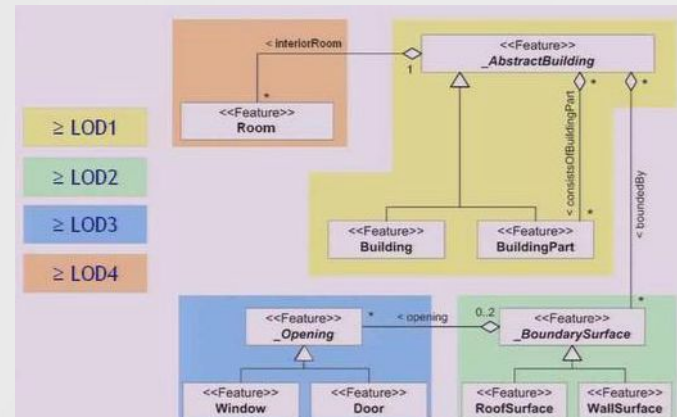
# Real time design and modeling

Design activity will become more interactive, developers will get to know the cost, sustainability and project schedule ( with 95% accuracy) before the project starts. They would exactly the following.

- Capital Investment
- Regulatory adherence
- Project time line
- Environmental sustainability
- Design
- Contractors
- Logistics



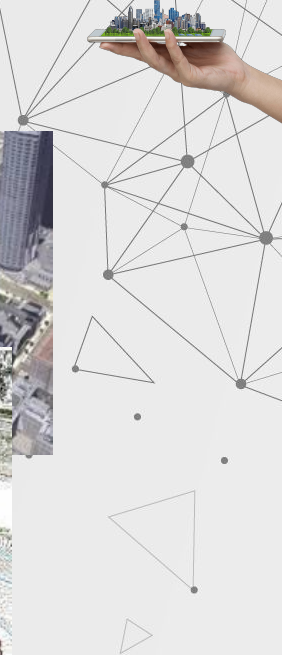
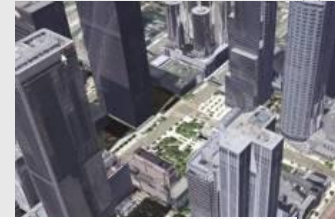
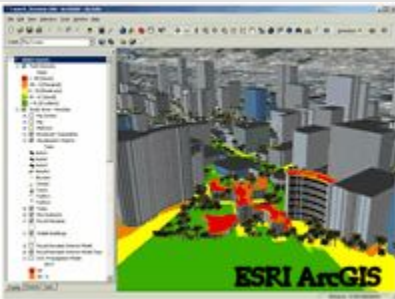
## cityGML





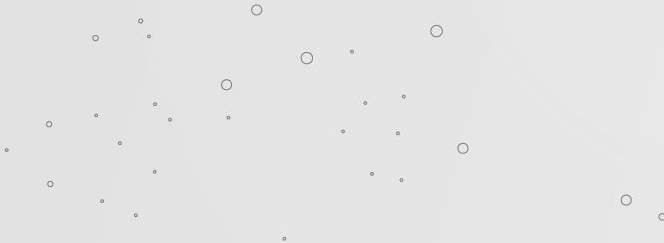
# Why is CityGML necessary?

- Increasing interest in 3D
- Research shown a definite need for 3D
- Standards led approach



# Web Services

- CityGML based on GML3 – combines with other OGC standards
- WFS, CS-W, WCTS and WPS especially
- Examples
  - OGC Web Services – 4 (OWS-4) Testbed – showed how cityGML/IFC 3D data can be used in disaster management
  - Statewide 3D SDI with cityGML – NRW. Noise modelling
  - SDI Berlin – city urban planning, civic participation etc
  - Heidelberg



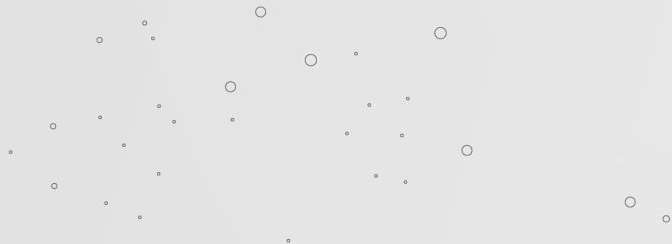
# Software supporting cityGML

- 3D Geo **LandXplorer** CityGML Viewer (free)
- University of Bonn: **Aristoteles** Viewer (free)
- Snowflake Software: **Go Loader & Publisher** WFS
- Interactive Instruments: WFS
- **Oracle** 11g: 3D data types and CityGML loader
- Tech. University of Berlin: **Oracle schema/loader/updater**
- Safe Software **FME** reader (writer in development)
- ESRI – ArcGIS 9.3 – **Interoperability Extension**
- **Bentley**: Work in progress
- **Autodesk**: Work in progress



# Extending CityGML

- 2 methods for extending basic functionality of cityGML
  - Generic Objects/Attributes
  - Application Domain Extensions
- Generics – allow extensions during runtime i.e. no additions to XML schema
  - Classes GenericCityObject & GenericAttribute
  - Only used for features not in cityGML model
  - Issues
    - May occur arbitrarily – no formal specification, reduces semantic interoperability
    - Naming conflicts may occur





# Application Domain Extensions

- CityGML – Base information model. Specific applications need extra information. E.g. Environmental simulations, Utility networks, etc
- Types of domain extension
  - Extend existing cityGML feature types
    - Extra spatial/non spatial attributes
    - Extra relations/associations
  - Definition of new feature types
    - Preferably based on cityGML base class CityObject
  - Each ADE requires its own XML schema definition





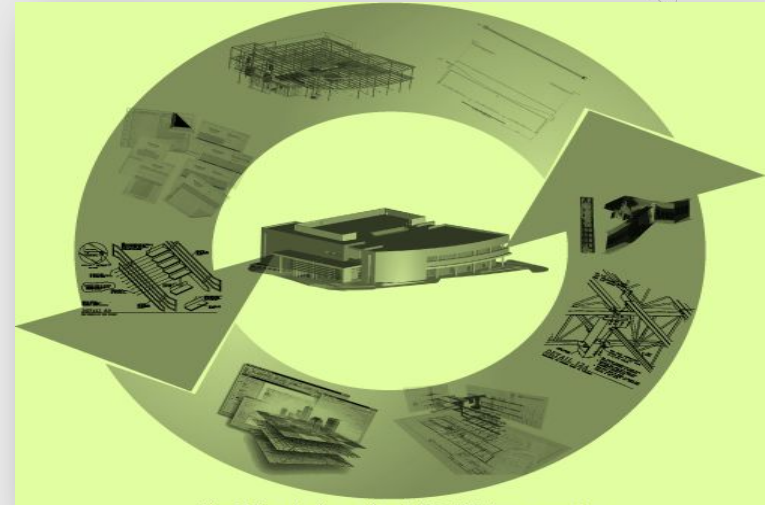
Large models:  
55 000 detailed buildings

Image: Reality maps, Berlin 3D

(>50km<sup>2</sup>)



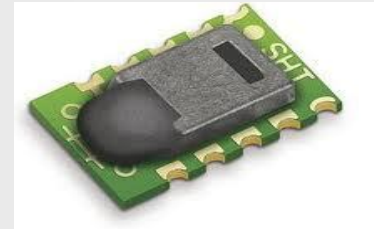
- GIS bring in **How to complement** strong spatial analysis of location and surrounding.
- GIS forms the base of the next level.
- BIM is good for Specific construction site analysis ( LOD 4 ), design, sharing and project management.





# Intelligent data collection- sensors

- Geo enabled Sensors play a vital roles in developing and managing smart cities.
- KPIs like, traffic, vehicular pollution, industrial pollution, energy consumption and resulting carbon foot prints are monitored using various types of sensors.



# Geo Business Analytics - GeoBI

- Display, query and analysis of large data is always a challenge for GIS users.
- GeoBI would help to query analyze huge volumes of data in very short time.
- GeoBI can also seamlessly work through number of sources and provide.



# What is OpenStreetMap?

- Geographic data
  - For driving, riding, walking, boating, skiing, hiking, anything
- Free
  - Currently CC-BY-SA, moving to ODBL
- Wiki-like editing



<http://www.osm.org>



# Available on many devices



OffMaps on iPhone



Garmin PNDs



Garmin GPSs



AndNav2 on Android



GPSPid on J2ME



Gosmore on Windows Mobile

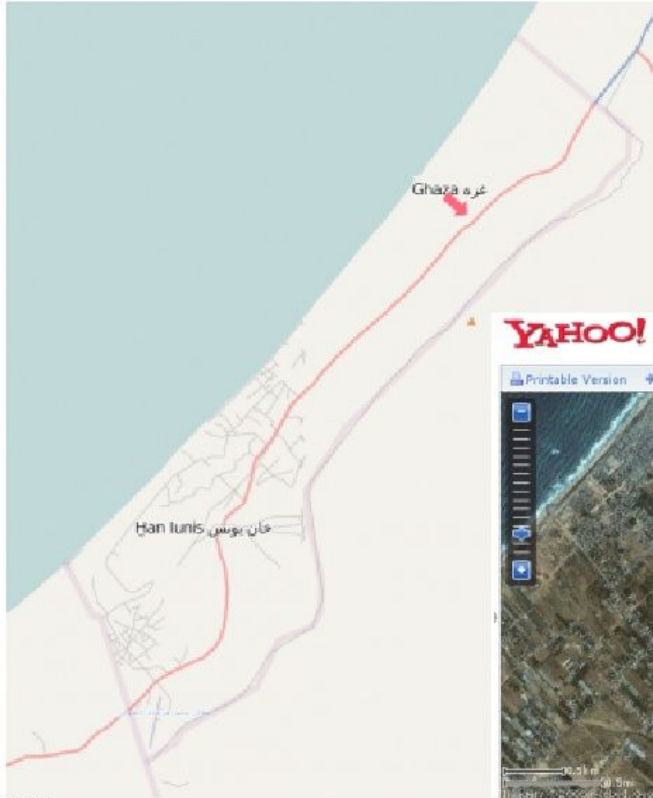


MaemoMapper on Nokia Maemo



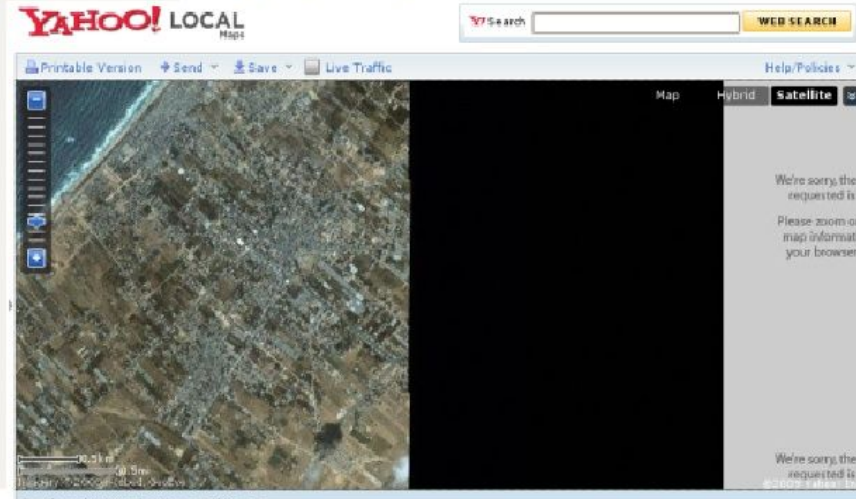


# OpenStreetMap Gaza Project

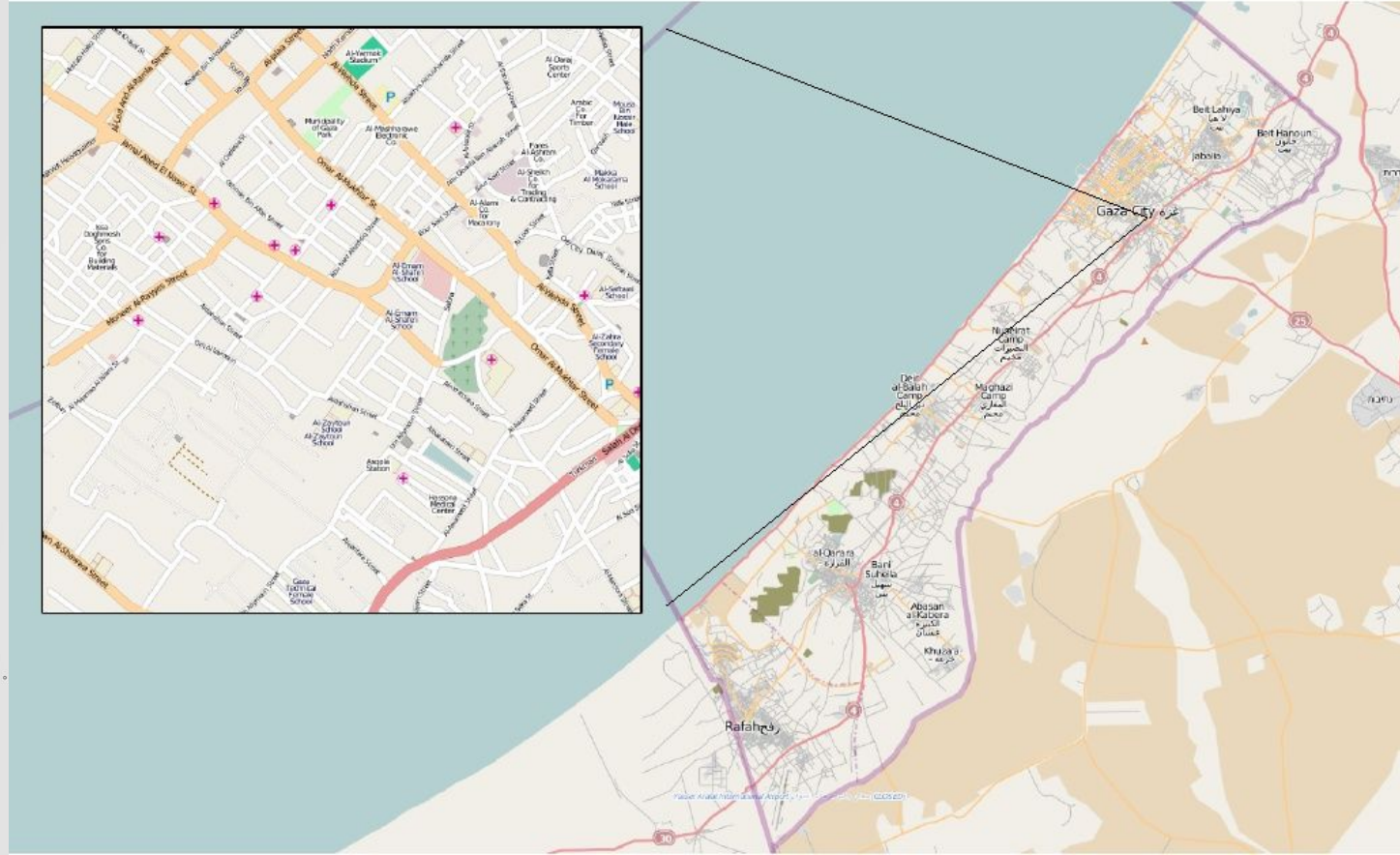


**Jan 2009:** Mikel Maron announces OpenStreetMap Gaza Project

**Feb 2009:** Mapping begins with purchased aerial imagery (~ \$6000)



# Gaza Strip today



## Use and Media Coverage

### Uses of OpenStreetMap data by crisis responders

People on-the-ground in Haiti (and related organisations) are using (or used) our maps:

- Thanks [message](#) from Colombian Mission in Haiti. (2010-02-10)
- "This is where OpenStreetMap is a godsend" in [How to Deploy Long-Distance WIFI in Haiti](#) (2010-02-10) by [Inveneo](#), a NGO whose mission is connecting those who need it most, on how they were able to bring high-speed Internet access - critical communication capacity - to eleven relief agency locations with minimal equipment and installation time.
- On 13/01/2010 [ITHACA](#) and [WFP](#) published their damage assessment of [Port-au-Prince](#) using OSM road data.
  - Special session on mapping the disaster during the Haiti Emergency at the [GI4DM 2010 Conference](#)  
See subpage [GI4DM2010](#)
- [OpenStreetMap renderings on Garmin GPS receivers](#) by Colombian search and rescue operators - "Many thanks Freddy. Very timely maps of Haiti that sent me to the Garmin. I went down and installed the GPS in our search and rescue teams. OSM undoubtedly be a great help to our response teams, especially those going to move to rural areas." via [ouounH](#) (2010-01-15)

#### Terms of Use

- Fairfax County Urban Search & Rescue Team Using
- Unitar / UNOSAT use OpenStreetMap street data in t
- GDACS use OSM street data in their reports
- JRC use OSM street data in their report
- "I'm told OSM is on the big monitors at SOUTHCOM.
- On 18/01/2010 [ITHACA](#) and [WFP](#) released maps
- NOAA's Environmental Response Management Appl
- The Food and Agriculture Organization (FAO) ([http://\(http://fenix.fao.org.8080/fenix-web/org.fao.fenix.we](http://(http://fenix.fao.org.8080/fenix-web/org.fao.fenix.we)
- The Office for the Coordination of Humanitarian Aff
- Wiki as a resource (Social Media Links category) for
- Secretary of State Hillary Clinton, Remarks on Inter
- Kjeld Jensen, Red Cross (IFRC): "Hello guys, I just wa
- is impressive. It has already saved me and my drive

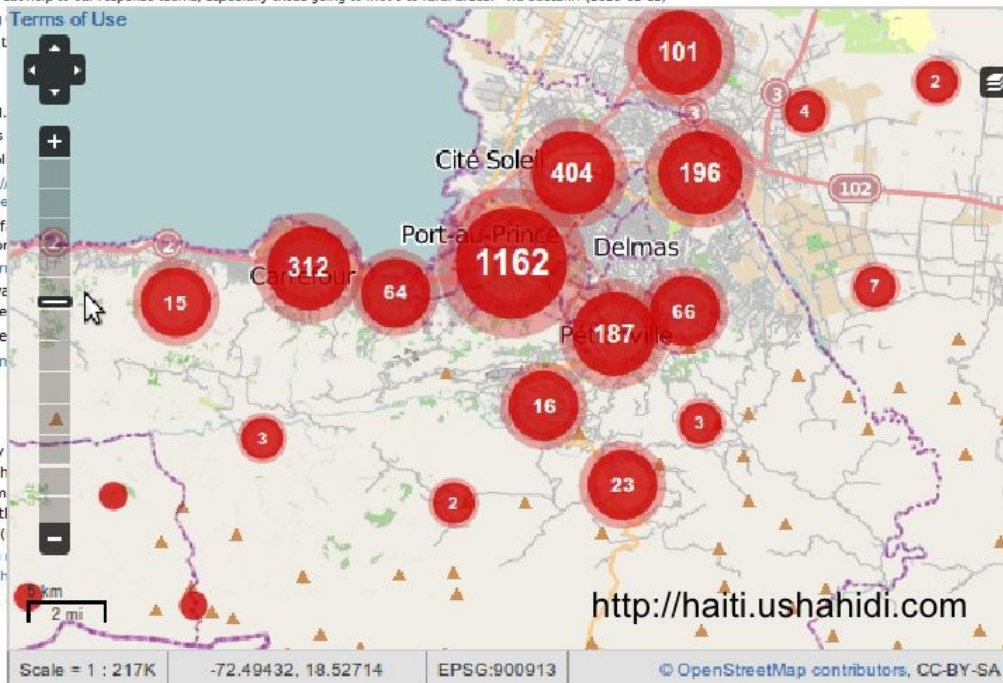
Again thanks a lot guys, we are really running fast here

- Jihad Abdalla from UNICEF (<http://groups.google.com>
- here...Million thanks."

Other earthquake related websites using our maps:

- [Atlas](#) compiled by the Center for Interdisciplinary
- [flickr.com](#) - the massive photo sharing site switch
- <http://haiti.ushahidi.com/> - plotting "reports" from
- MapAction (<http://mapaction.org>) use OpenStreet
- Information Management & Mine Action Programs (
- World bank printed a giant poster for their SitRoom
- OpenStreetMap data is being shipped on drives to th

There are many alternative renderings/map views too.







## Use and Media Coverage

### Uses of OpenStreetMap data by crisis responders

People on-the-ground in Haiti (and related organisations) are using (or used) our maps :

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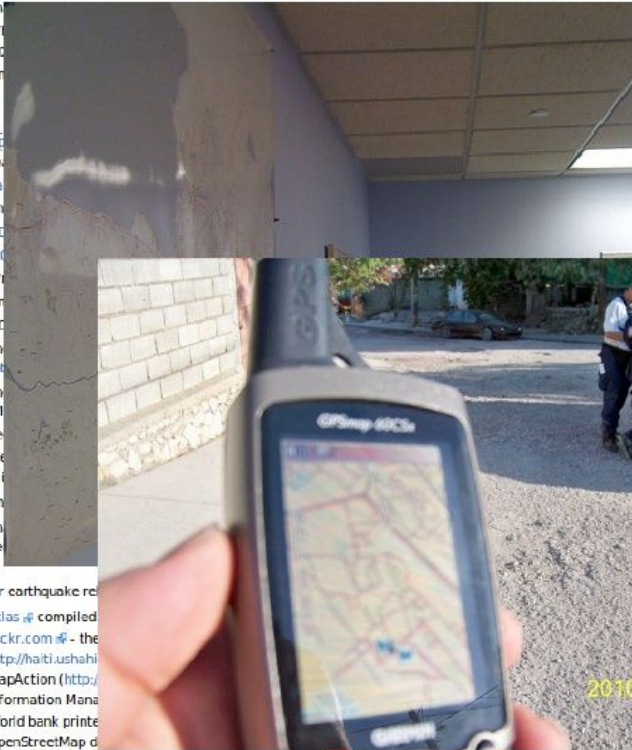
Other earthquake re

- » Atlas  compiled
- » flickr.com  - the
- » <http://haiti.ushahidi.com>
- » MapAction (<http://www.mapaction.org>)
- » Information Mana
- » World bank printe
- » OpenStreetMap d

There are many alternative renderings/map views too.



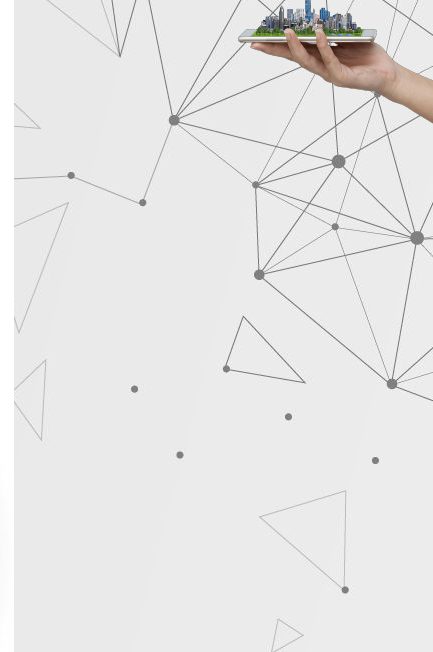
An introduction to OpenStreetMap



"Hello guys, I just wanted to let you know that your work on improving the Haiti maps is really appreciated here. A few days ago I installed a version on my Garmin Oregon GPS and the result is impressive. It has already saved me and my driver from getting lost twice, and the alternative would have been long delays. In the coming days I will try to update our Red Cross relief GPS receivers with your map." - Kjeld Jensen, Red Cross (IFRC)



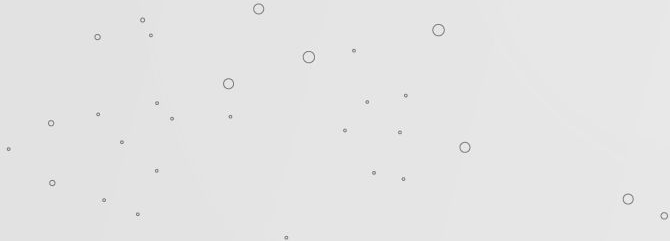






# Conclusion

- Geospatial shall a very vital role in future 'smart city' initiatives .
- If Sustainability is the way forward for future cities. There is NO way forward with Geospatial platforms in place
- Integration, ability to work with GIS & BIM ambidextrously will yield great results.

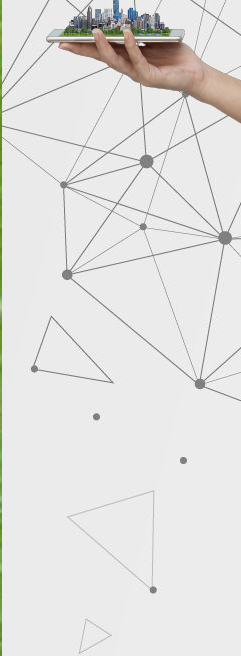
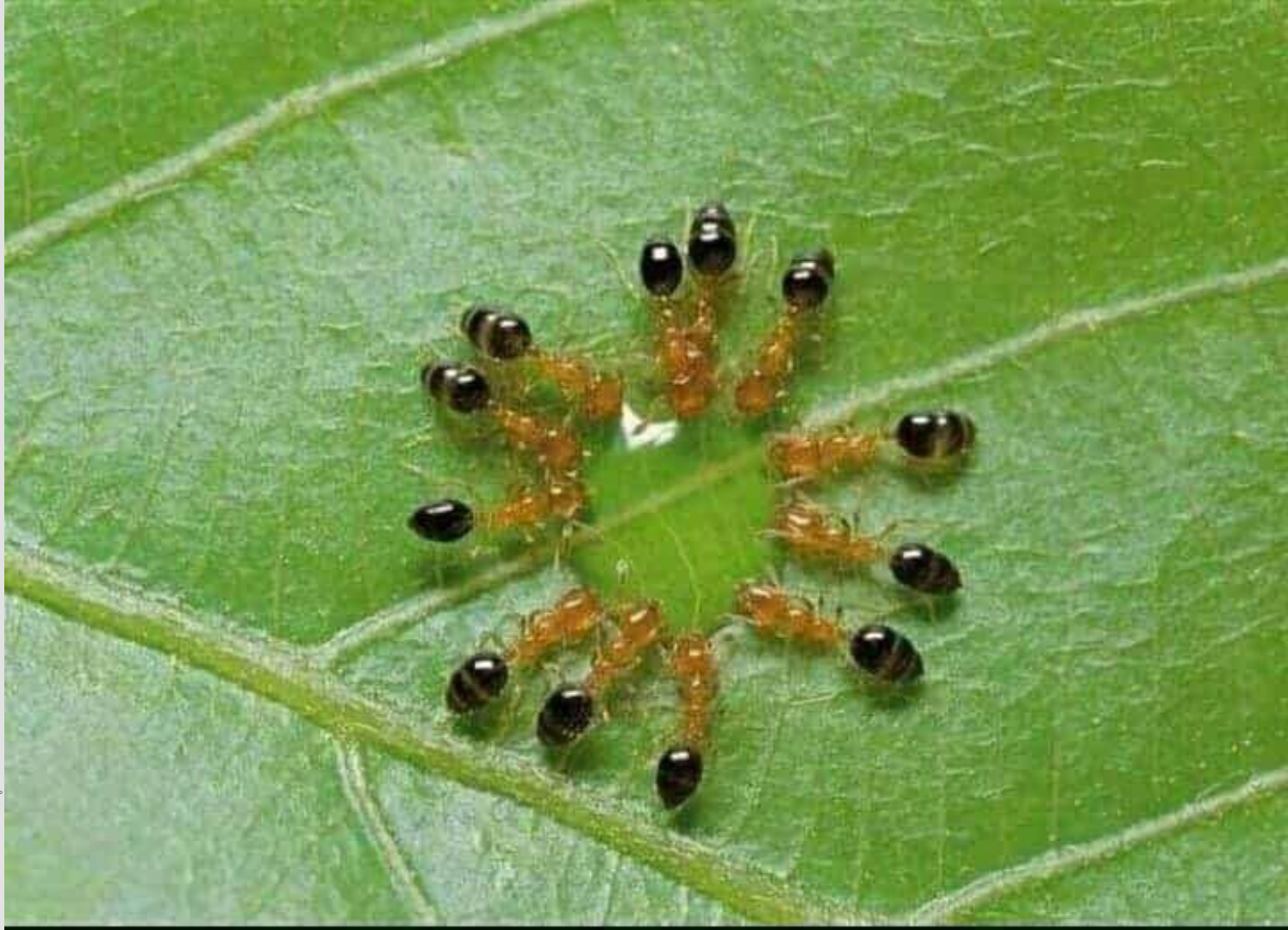






# Examples Of Smart City



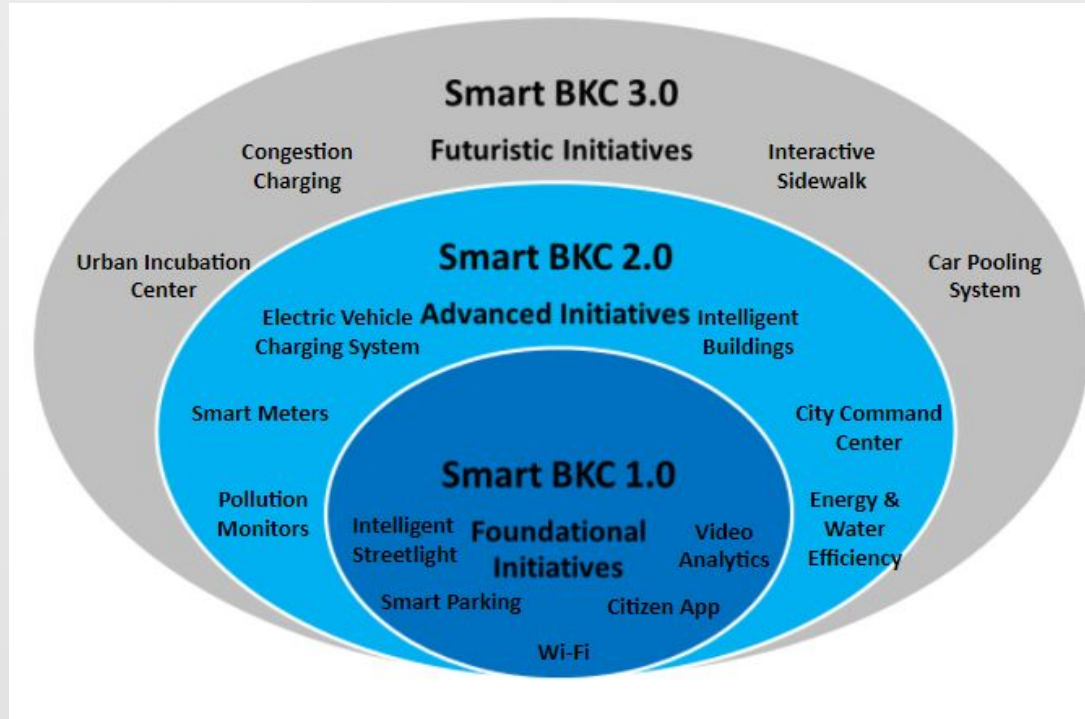






# Smart BKC Plan- Phases

MMRDA has started its Smart City journey with focus on creating BKC as Intelligent Region and identified Top 5 solutions to create foundation for Smart BKC.



## Technology evolution to a smart city

Smart

Integrated

Managed

Networked

Measured

Pervasive **sensor networks** throughout city

Node connections through low-cost **communications**

**Real-time** analysis and control of city systems

**Integration** of isolated systems and across cities

SaaS-based citizen **services**, applications, and management tools

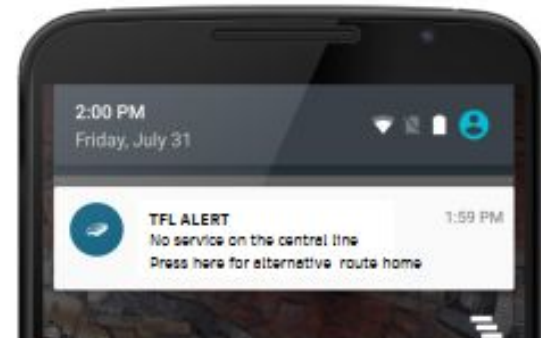
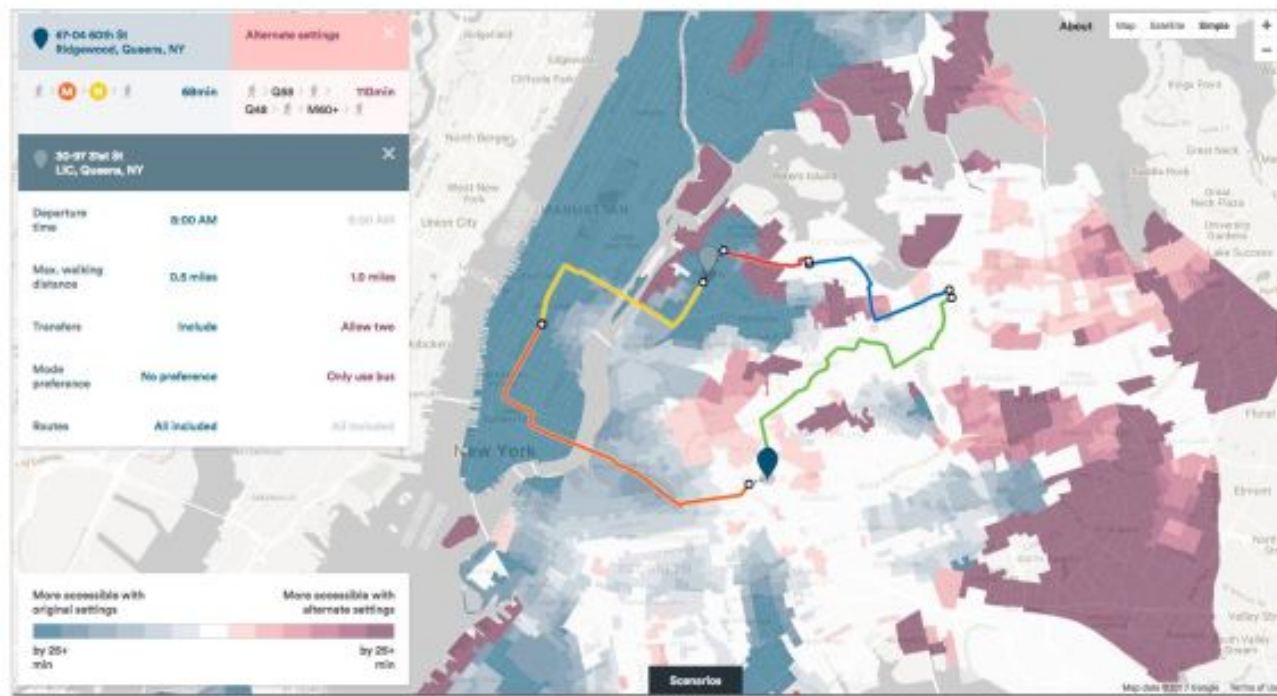
Smart cities are enabled by recent advances in key technologies:

- Pervasive sensor networks
- Low-cost communications
- Software-as-a-Service

Step-by-step approach to becoming smarter



# Transit delays and cancellations – lead to frustrated passengers and over crowded stations



Alerts to users with alternative route calculated on busyness and travel history



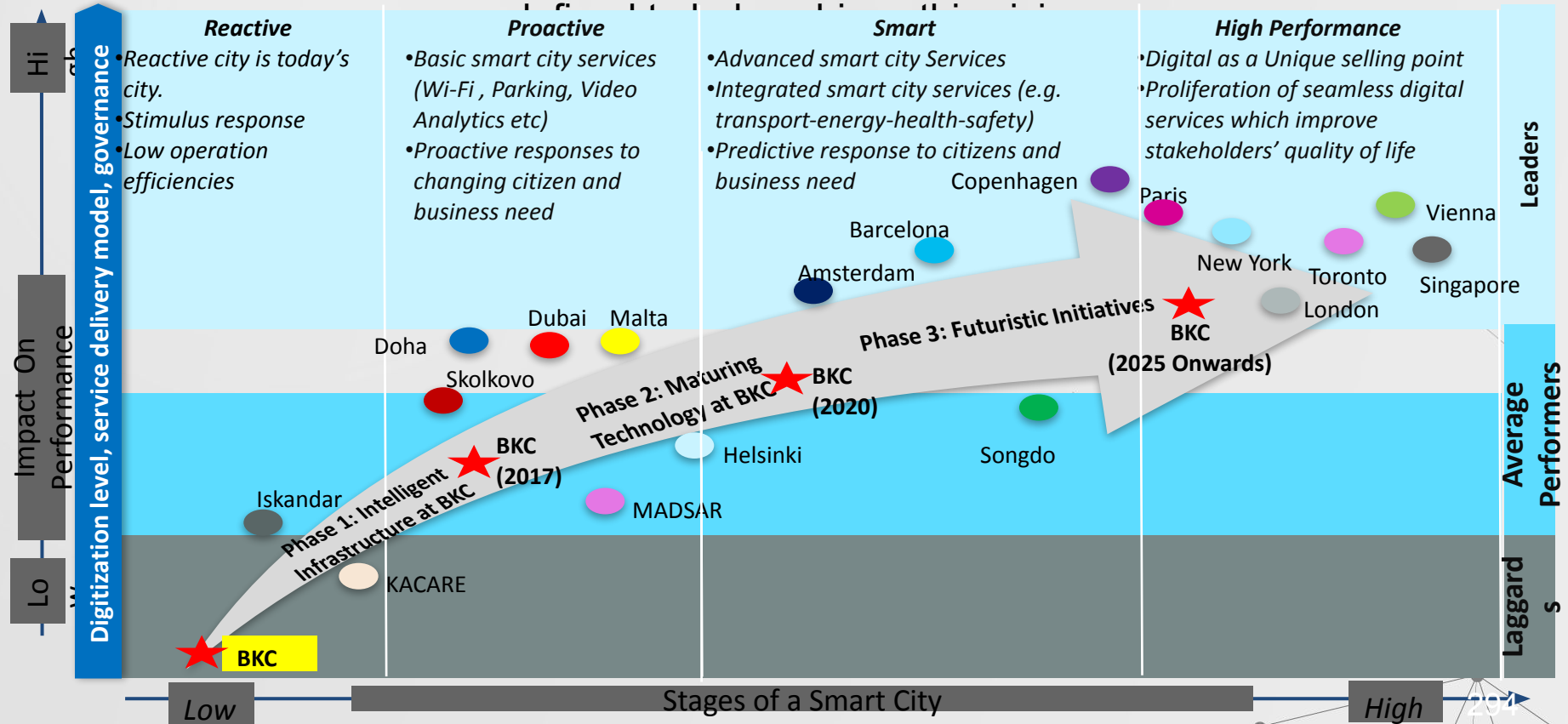
Interactive totems outside the station provide information and alternative routes

Use data to pre-plan alternatives and understand impacts elsewhere

Example: Sidewalk Labs LLC's L line shut down in NY








Based on the various smart cities across the globe,  
a smart city Journey for Bandra Kurla Complex is





## 5 initiatives earmarked for Smart BKC 1.0, Making BKC as a Smart City

1.Public WIFI 	2. Smart Parking 	3. Smart Street Lighting & Grid 	4. Video Analytics & Surveillance 	5. Citizen Apps 
5 MBPS High Speed Wireless Internet Connectivity	3000 Smart Parking Slots	841 Streetlights based on Solar power	Complete E & G Block covered with 90 cameras	33000 man-days saving due to ease of access of information
175 Hectare Area Covered in Public Wi-Fi in BKC	Parking Time Reduced from 20 minutes to 5 minutes	800 tonnes of Carbon Reduced Annually	Greater coordination among Security Agencies	Improves Citizen Communication
Seamless Wi-Fi Connectivity Across E& G Blocks	19000 Liters of Fuel saved annually	Energy Consumption reduced by 40%	Reduced Street furniture theft	Improved Emergency Alert and Response
50,000 man days saved per year	24 tonnes of Carbon Reduced Annually	200KW of Clean energy generated	Improved Emergency Response	6.5 lakhs Employees Covered
Public Wi-Fi as Value Added service for Business and Exhibition Use	Reduction in Unauthorized Parking	Reduced Maintenance Cost	Secured Business Environment	Increase in ease of Business in BKC

Cost Estimates	
• Capex: Rs 19.41 Cr.	• Break Even: 7.38 years
• Opex 1 <sup>st</sup> yr: Rs 5.51 Cr.	• Total Project Period 10 years
• Annual Revenue generated: Rs 7.91 Cr.	• IRR : 16%

Present Status
• EOI Received on 02.12.2014 and scrutiny under progress
• <b>23 Lead bidders have participated with 2 global consortium and 21 Indian Firms</b>

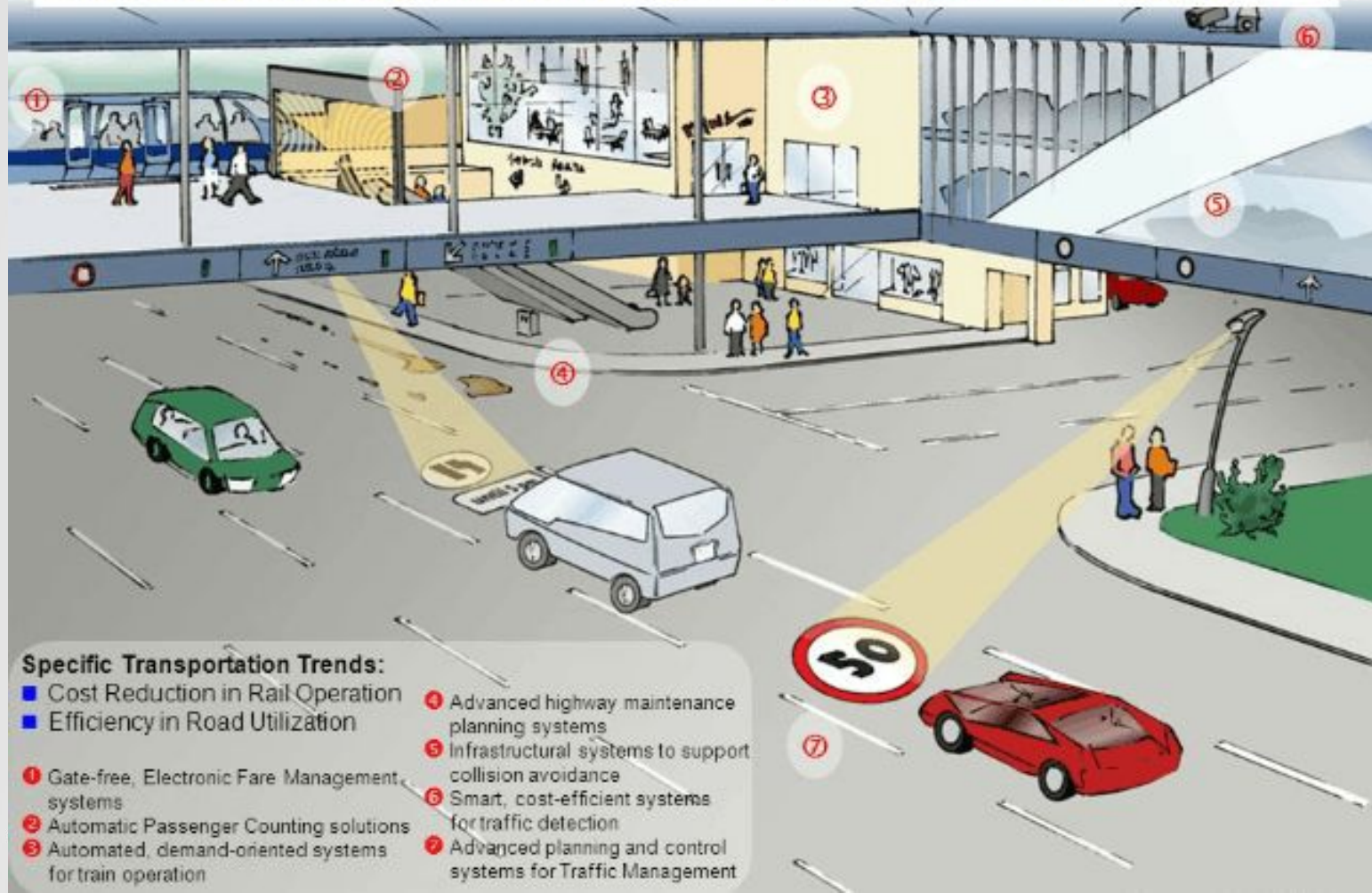


## Next Phase Once phase 1 Smart BKC solutions have been implemented additional initiatives can be build upon the existing capabilities as next quick wins

Wi-Fi	Smart Parking	Intelligent Streetlight	Video Analytics	Citizen Mobile Application
<ul style="list-style-type: none"><li>▪ BKC Wide Wi-Fi</li><li>▪ Communication Backbone for Parking Sensors, CCTVs, Kiosks</li></ul>	<ul style="list-style-type: none"><li>▪ On Street, Open and In Door Parking</li><li>▪ Parking Guidance App</li><li>▪ Parking Space Management</li><li>▪ Parking Reservations</li></ul>	<p>Lighting</p> <ul style="list-style-type: none"><li>▪ Light &amp; Motion Sensor</li></ul> <p>Solar</p> <ul style="list-style-type: none"><li>▪ 200 kw Grid Tied Solar PV</li></ul>	<ul style="list-style-type: none"><li>▪ 50 new cameras to cover entire BKC</li><li>▪ Integration with Mumbai CCTV</li><li>▪ Command Center at MMRDA and BKC Police St.</li></ul>	<ul style="list-style-type: none"><li>▪ BKC Information</li><li>▪ Key Contacts</li><li>▪ Citizen Involvement Mobile App</li><li>▪ Kiosks</li></ul>
<p>Extend for more Smart City Apps</p> <ul style="list-style-type: none"><li>▪ Air Pollution Sensors</li><li>▪ Smart Meter (Electric/Water/Gas)</li><li>▪ Water Quality Meters</li><li>▪ Flood Sensors</li></ul>	<ul style="list-style-type: none"><li>▪ EV Charging Stations</li><li>▪ EV Charging Station Locator</li><li>▪ Differential Parking Charging</li></ul>	<p>Lighting</p> <ul style="list-style-type: none"><li>▪ LED Retrofit Lighting</li></ul> <p>Solar- expand to 1 MW</p> <ul style="list-style-type: none"><li>▪ Solar PV on Buildings (Terrace and Façade)</li><li>▪ Solar PV on Bus Stops</li></ul>	<ul style="list-style-type: none"><li>▪ Extend Command center at MMRDA to City Command Center</li><li>▪ Feed to Transportation Planning</li></ul>	<ul style="list-style-type: none"><li>▪ Citizen Involvement in Planning</li><li>▪ Citizen Services -GIS and ERP Integration</li></ul>



## Smart Traffic Management Increases Infrastructure Efficiency



### Specific Transportation Trends:

- Cost Reduction in Rail Operation
  - Efficiency in Road Utilization
- |  |  |
|--|--|
| ① Gate-free, Electronic Fare Management systems          | ④ Advanced highway maintenance planning systems                |
| ② Automatic Passenger Counting solutions                 | ⑤ Infrastructural systems to support collision avoidance       |
| ③ Automated, demand-oriented systems for train operation | ⑥ Smart, cost-efficient systems for traffic detection          |
|  | ⑦ Advanced planning and control systems for Traffic Management |

# Bengaluru

## Area Based Development

- **Revitalization Of Historic Heart Of City**
- Infrastructure revitalization (increase in capacity and coverage)- power, sewage system, water supply, Surface drainage, and telecommunication
- The city center needs the highest degree of walkability due to the highest footfall number
- **Integrated Mobility Towards Creating Vibrant Destination**
- Building on Tender SURE and Proposed Metro Station
- Combining Shivajinagar bus depot to Russell Market through an overhead pedestrian bridge
- Reuse of underutilized public area and infrastructure towards economic viability
- **Upgradation & Redevelopment Of Historic Economic Centres**
- Retrofitting of the historic market center through improved public transport connectivity and effective distribution management
- Proficient vending and increased retail footstep through effective space management
- Desegregating the proposed metro station to market through an overhead pedestrian bridge
- **Innovation Of Downstream Clean Up Of Drainage System**
- Green drives for water body clean up
- Improved groundwater recharge
- Creating a lively and accessible public space within the ABD
- **Preservation And Redevelopment Of Centrally Located Parkland**
- Revitalizing the central city through pedestrian connectivity and placemaking
- Desegregate the green network for heritage and cultural places around Kabban Park
- **Increasing Affordable Housing Stock Through Slum Development**
- Upgrading of housing units
- Physical infrastructure – sanitation, street lighting, roads, and water supply
- Social infrastructure – Community Center
- **Health Care Facility Retrofitting**
- Health care center construction redesigned
- Heritage protection of building



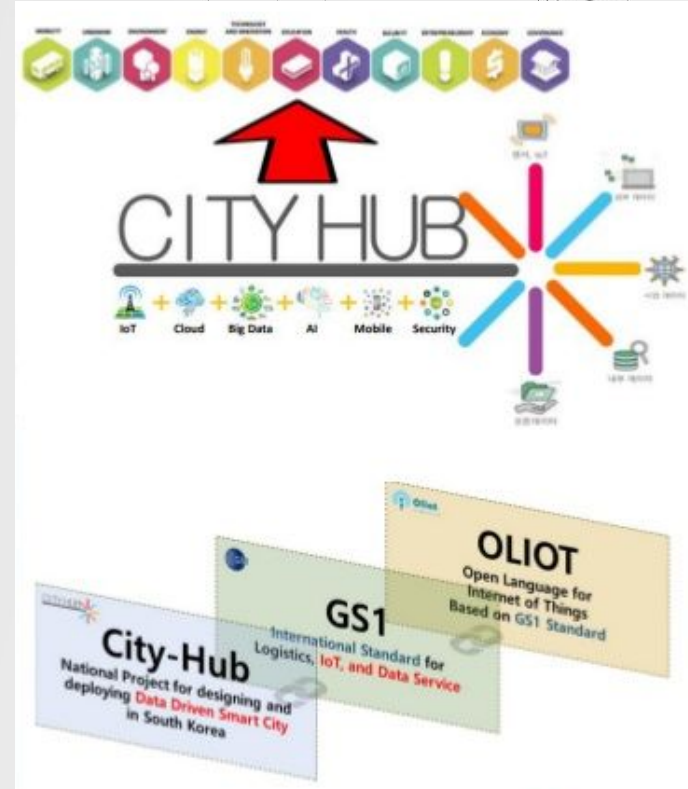
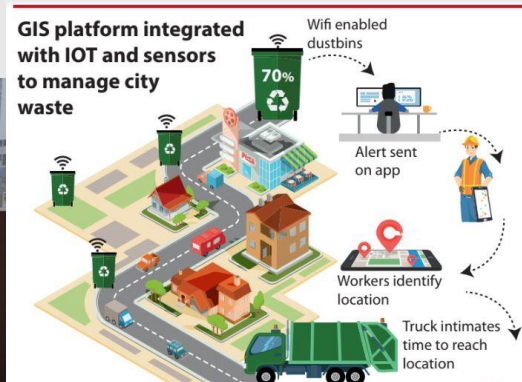
# Seoul

Capital of South Korea

## Clean up the city,

Recycling bins were linked to computer network ,  
that received live updates on the bin's fill level

More efficient collection routines Within 3  
months cost cut by 83 %



# Songdo city in south Korea

The Korean government has devised a growth strategy Economic by making Korea the business hub Northeast Asia and its transformation into an economy Knowledge-based and service delivery.

This strategy involves creating three Growth poles of reclaimed land, Help create proximity to an airport Incheon

These poles are: **Songdo, Cheongra, and Yeongong**, and they constitute three free economic zones

**It occupies the first place in the global ranking of smart cities as the largest city  
It was developed using LEED Leader in Energy and Environmental Design In  
energy and environmental design.**





**Arrival  
Estimation  
Service**

**Traceability  
Service**

**Recall  
Service**

**Nearby  
School  
Service**



**Advertise-  
ment  
Service**



**Korea, Busan Bus**



**Spain, Santander Bus**

**Manufacturing Data**

(Parts, Factory,  
Manufacturing date)

**Registration/  
Inspection Data**

(VIN, Plate Number,  
Reg. Number, Owner,  
Inspection Data)

**Sensor Data**

(Location, Speed,  
RPM)



**Accident Record  
Data**

(Date, Location,  
Damages)

# Barcelona

reducing traffic with s. Parking system,

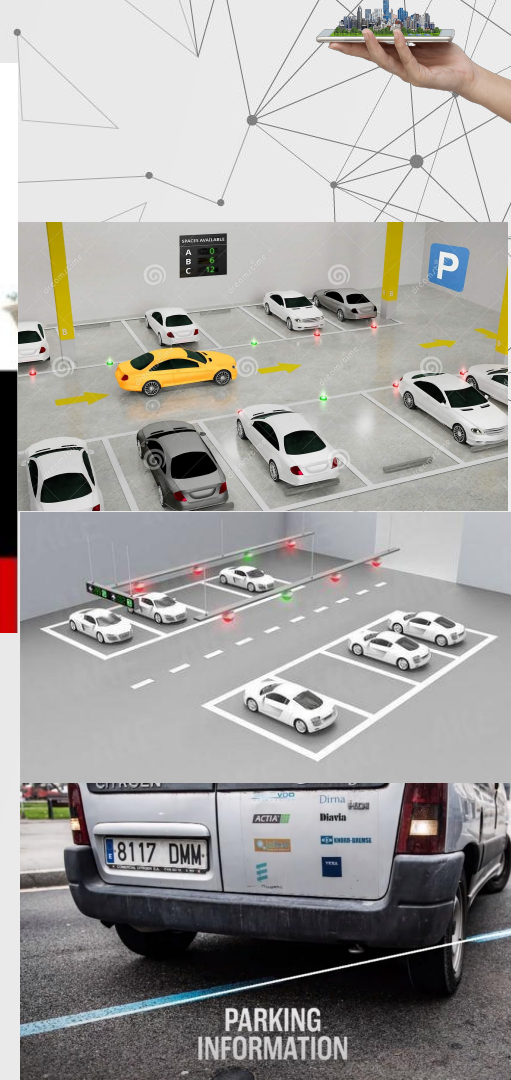
40 % of traffic is caused by drivers looking for parking spaces.

by installing sensors across the city- use s.phone APP . Live feed

**reduced waste time** increased better traffic flow . Save environment and petrol , data parking pattern .

Create an ecosystem that industry and academia cooperate under the shared value

- Open various city public data → Drive development of creative smart city services
- Operate data-driven City OS platform
- Based on IoT platforms



## How Smart is Barcelona?

- Europe Innovation Capital of 2014
- Mayor Bloomberg Innovation Challenge Winner 2014
- BCN Open Challenge crowdsources solutions for 6 major city problems







Virtual Singapore

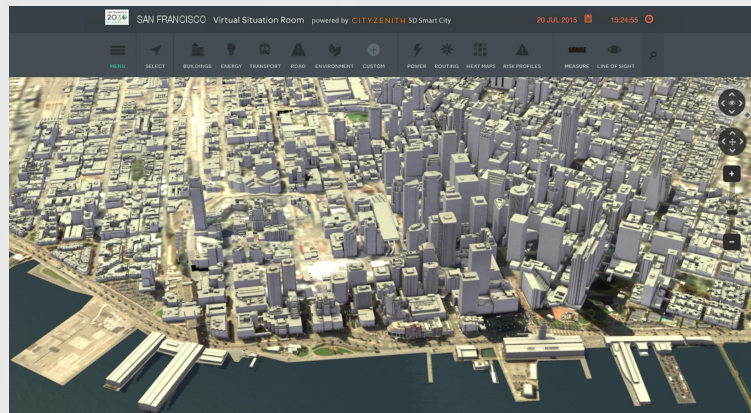


Berlin's 3D City Models



San  
Francisco  
virtual  
situation

Manchester



# London

SCOOT traffic system,

online computer monitors **live traffic flows** from **15,000 detectors**

and **optimizes signal timings** across traffic lights,  
has **reduced delays** in the UK capital

## Metro

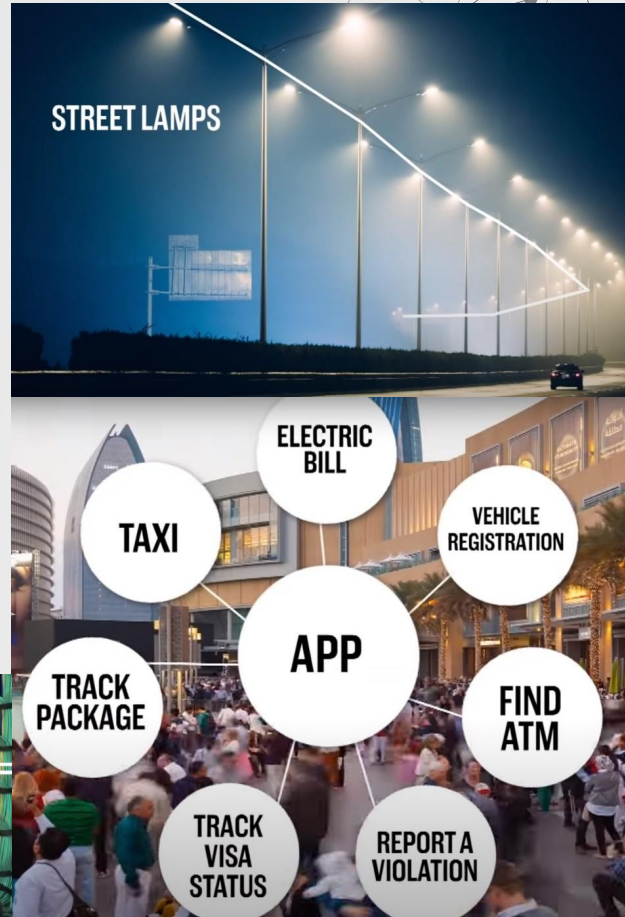
Collect energy while using braking

Within week – generate energy enough for 2 days operating using one reflector only .

[https://maps.london.gov.uk/lbsm-map/public.html?fbclid=IwAR0FXy2FzfUKDkSE\\_q-BVbDgTYFzy6SJJK-iv-yuPCosnSy65tXAC4CHl4s](https://maps.london.gov.uk/lbsm-map/public.html?fbclid=IwAR0FXy2FzfUKDkSE_q-BVbDgTYFzy6SJJK-iv-yuPCosnSy65tXAC4CHl4s)  
<http://www.imactivate.com/>

<https://westyorks-ca.maps.arcgis.com/apps/webappviewer/index.html?id=a186b1f088734f58acafc67e71ba306e>

<https://odileeds.github.io/traffic-growth/>  
<https://epc.opendatacommunities.org/domestic/search>





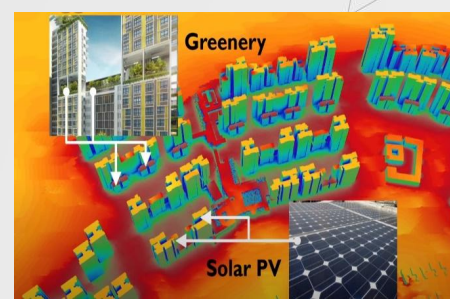
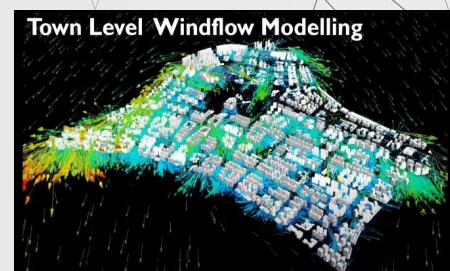
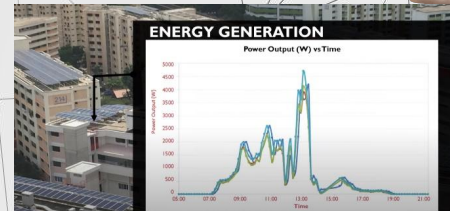
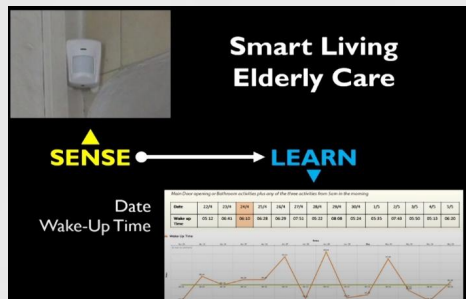
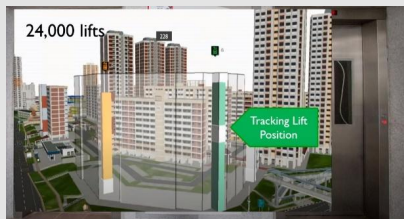
# Singapore

ranked **top** in **mobility**, **health**, **safety** and **productivity**

smart technology to improve the **flow of traffic**  
reduce the number of vehicles on its roads.

**smart video surveillance** to detect **criminal activity**

and used **digital service platforms** and **remote monitoring devices** to increase, and improve, access to **healthcare**, particularly among its **older citizens**.



<https://www.sgbike.com.sg/>



CITY FLOW DATA  
ASSET TRACKING  
SENSOR PLATFORM  
DATA CONNECTIONS



# Cyberjaya city in Malaysia

The city is 40 km from

The Malaysian capital, Kuala Lumpur, reaches

Its area is about 7000 acres.

It is considered the first smart city in Malaysia . Opening it to be a corporate center International Information Technology

## The stages of establishing the city

**In the first year:** attention was directed to

Facilities and infrastructure design As basic as postal service and methods Access and communications infrastructure.

- **In the second year:** raising the efficiency of the structure IT infrastructure Communications and commercial facilities.

- **In the third year:** the high quality of the structure IT infrastructure and facilities And communications.





## City goals

**Make the city an investment center, my favorite  
For technology companies with a reaffirmation  
On its current location as the prime location  
For information and communication technology.**

**Promote an attractive investment ecosystem  
Targeted.**

**Encouraging the private sector more  
Investment incentives to create  
Their companies in this city are exploiting  
Information and communication technology.**

**Create high-tech job opportunities  
For Malaysians.**






## smart applications in the City

- **E-government:** It is the main application and includes the Federal Administration Center in Putrajaya is the main factor in e-government development. It will be used Information and communication technology to allow citizens and businesses to communicate with Government agencies efficiently, and vice versa.
- **World's first multipurpose card:** This project created a smart card "MyKay", to replace your old ID card. It is used like a credit card. ATM bank card, driver's license, health ID card, and card Security identity.
- **Smart schools:** where smart schools are provided with internet facilities and technology Information and communication to allow students to participate in virtual classes And gain knowledge of using technological facilities.
- **Research and Development Group:** includes the development of information technology research and development And communications by encouraging institutions, companies and academic institutes To collaborate in research. Hence, this effort could cultivate generations of Young people in creative information and communication technologies.

## smart applications in the City



- **Telehealth:** This project provides healthcare services from: Through telematics and telecommunications. Multimedia Corporation Super Corridor also aspires to be the regional healthcare hub for Distance or telemedicine.
  - **E-business:** is to encourage local and international companies that have been established Internet or multimedia business
  - **Technology Entrepreneurship Development:** This is a new enterprise expansion project Information and communication technology in the world (small and medium) in Malaysia.
- 

- The city is considered the most expensive city to be built from The private sector worth more than 35 billion Besides, dollars are a landmark Cisco smart.
- Designed and supervised by a partnership between Cisco Technology Advanced International Agent and Morgan Stanley.
- It has adopted high-tech sensors in all buildings And streets to assess and adjust the amount of energy consumption
- The city has wireless communication networks that link all information systems either Whether it is residential, commercial, medical, or government, on the World Wide Web.
- Cisco has prepared connections between every inch in the city and installed devices Electronic sensor on the roads leading to it





*“Future technologies form the cornerstone for **NEOM’s** development:*

*disruptive solutions for **transportation** from **automated driving** to **passenger drones**,*

*new ways of growing and processing food, **healthcare** centered around the patient for their holistic well-being,*

*wireless high speed internet as a free good called ‘**digital air**’, free world-class **continuous online education**,*

***full scale e-governance** putting city services at your fingertips,*

***building codes** that make **net-zero carbon houses** the standard,*

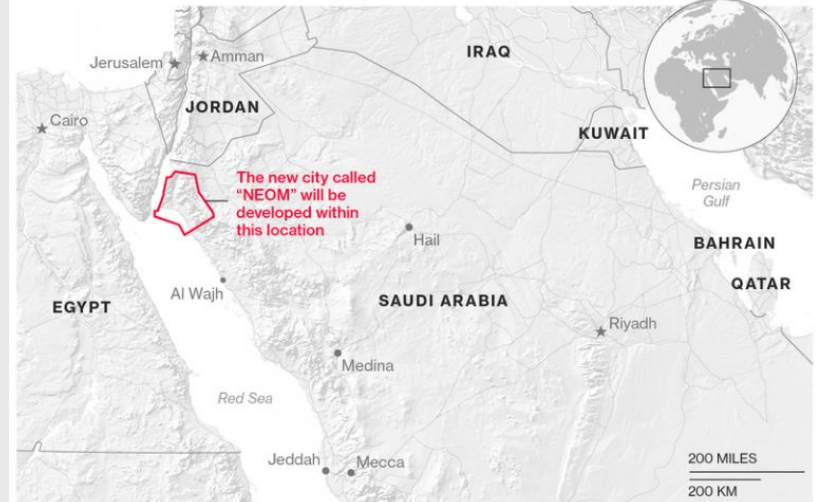
*a city layout that **encourages walking and bicycling** and all solely powered by **renewable energy** just to name a few.*

*All of this will allow for a new way of life to emerge that takes into account the ambitions and outlooks of **humankind paired** with best future technologies and outstanding economic prospects.”*

*“We will build the city from scratch,” said **Crown Prince Mohammed bin Salman**. “It will be **drone-friendly** and a center for the development of **robotics**. We want to create something different. NEOM is a place for dreamers who want to create **something new** in the world, something extraordinary*

#### Saudi Arabia's New Mega City

The development will be on the Red Sea coast, and stretch into Jordan and Egypt



Source: discoverneom.com

Bloomberg

**saudi arabia unveils THE LINE, a linear development of smart cities connected without cars**



## WHAT IS THE LINE?

A REVOLUTION IN URBAN LIVING  
COMMUNITIES WILL BE FORMED ALONG THE LINE

**100%**

renewable  
energy system

**170km**

long city of one  
million residents

**20mins**

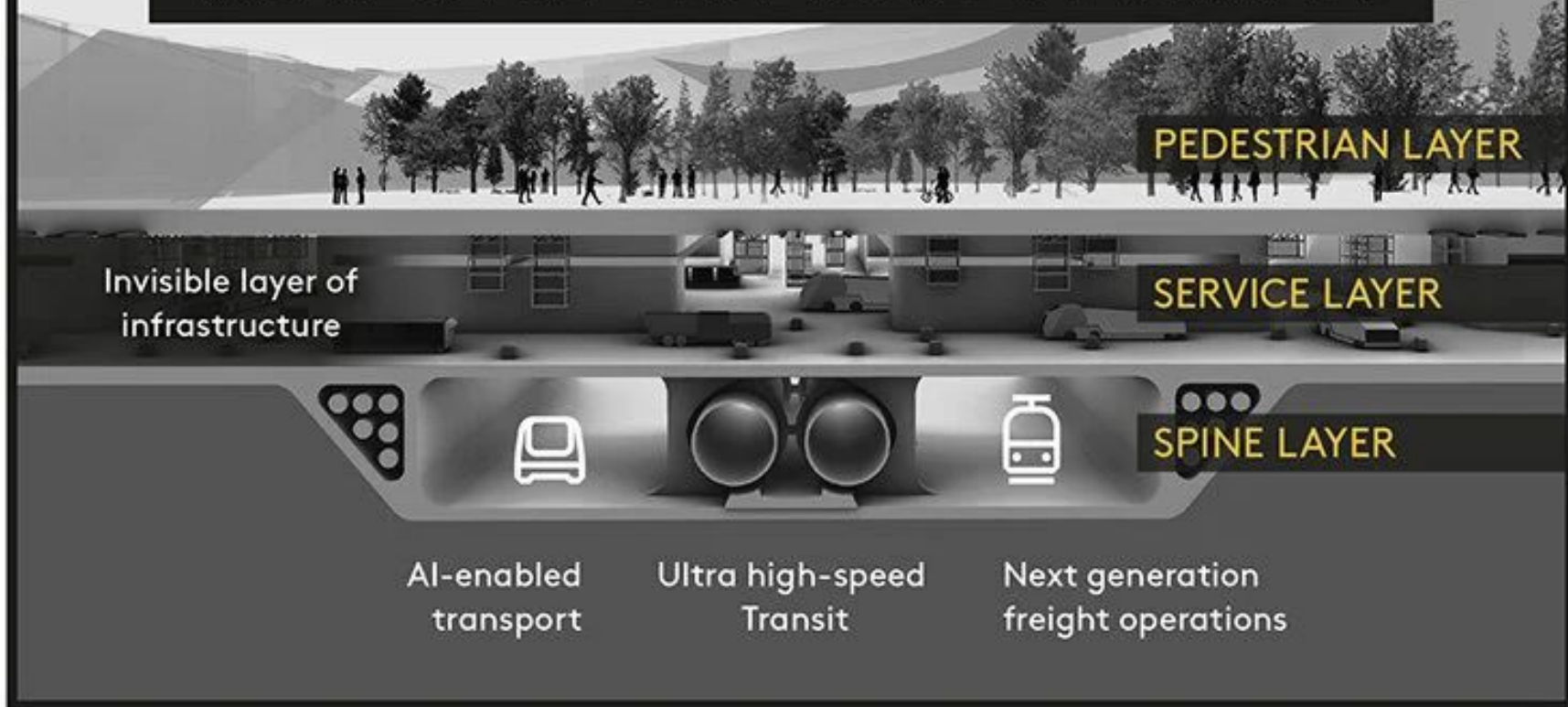
will be the  
longest journey  
time end to end

**95%**

of nature in NEOM  
land is protected



# HOW WILL THE LINE OPERATE?





# CONGESTION



THE LINE

0%

CONGESTION

THE LINE –  
zero cars,  
zero streets.

OVER THE PAST DECADE, CONGESTION IN  
MAJOR CITIES HAS INCREASED

PARIS

9%

BEIJING

9%

LONDON

14%

NEW YORK

30%

LOS ANGELES

36%

Drivers in the top 10 most congested  
cities lose on average 168 hours per  
year due to congestion

## Barcelona Smart City's governance model

### EXTERNAL



Citizens



Entrepreneurs



Businesses



Investigation centers



Universities



International Events  
(Smart City Expo,  
Mobil World Congress...)

STRATEGIC

SMART CITY DIRECTOR

BIT

EXECUTION

STRATEGY

TACTIC

COMMUNICATION

SMART PMO

INTERNATIONAL PMO

SMART GOVERNANCE  
TEAM

PROGRAMS

OPERATIVE

PROGRAM n

HEAD OF PROGRAM

Responsible for  
monitoring

Technical leader

Business leader

Project  
leader

Project  
leader

Project  
leader

...

Tech.  
Partner

Tech.  
Partner

Tech.  
Partner

...

### CITY COUNCIL



Mayor



Corporate  
departments



Service  
departments



Other public sector  
organizations/agencies





MASDAR



# MASDAR

- Funded by Mubadala Development Company
- Designed by Foster + Partners
- Powered entirely on solar energy and other renewable energy sources
- Zero-carbon, zero-waste ecology
- Abu Dhabi Future Energy Company (ADFEC)
- Projected to cost US\$22 billion
- Started in 2006,
- First phase 2009
- 2.3 sq mi
- 50,000 people
- 1,500 businesses





# MASDAR

- Masdar Institute of Science and Technology (MIST)
- Automobiles will be banned within the city
- Public mass transit and personal rapid transit systems
- City will be walled, to keep out the hot desert wind
- Narrow, shaded streets that will also funnel breezes
- Partners include through the Clean Tech Fund, GE, BP, Royal Dutch Shell, Mitsubishi, Rolls-Royce, Total S.A., Mitsui and Fiat



# MASDAR

- Power Sources
- 40 to 60 megawatt solar power plant, built by the German firm Conergy (construction activity)
- Larger facility and additional photovoltaic modules will be placed on rooftops to provide supplemental solar energy totaling 130 megawatts
- Wind farms will be established outside the city's perimeter capable of producing up to 20 megawatts
- Geothermal power
- Hydrogen power plant
- The city will not produce enough energy to power itself at night
- Import gas-fired power from Abu Dhabi's grid
- Carbon accounting by exporting excess solar power to the grid during the day



# MASDAR

- Water
  - Solar-powered desalination plant
  - 60 percent lower water needs than similarly sized communities
  - 80 percent of the water used will be recycled
  - Attempt to reduce waste to zero
  - Biological waste will be used to create nutrient-rich soil and fertilizer
  - Waste incineration as an additional power source
  - Recycle

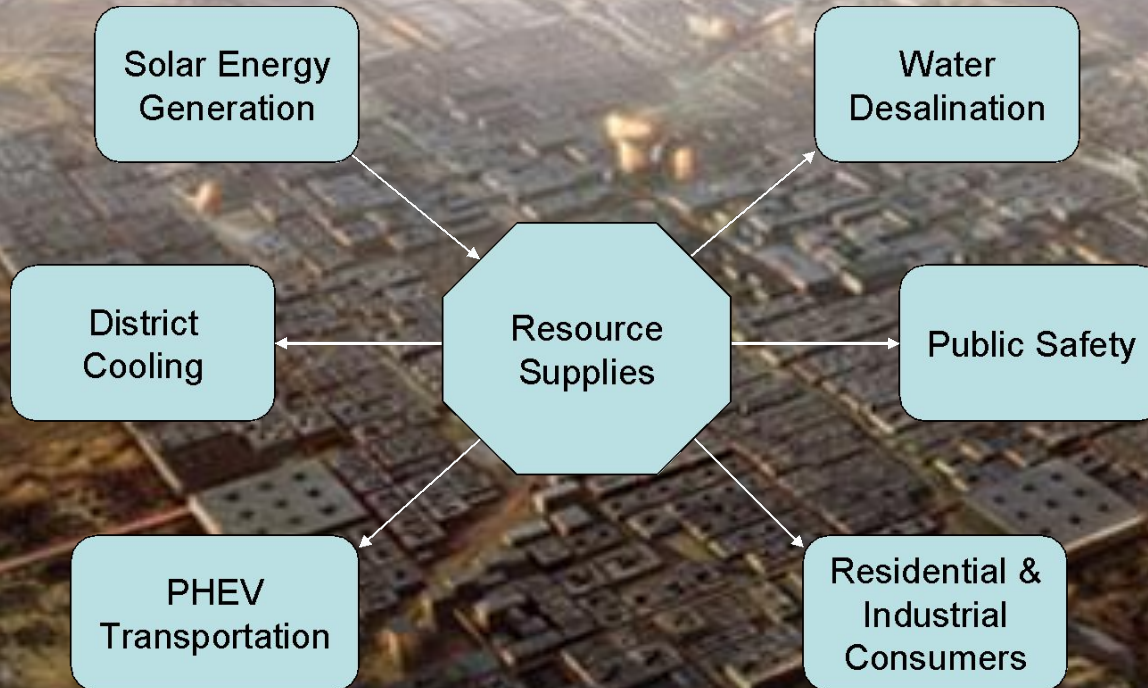


masdar-headquarters



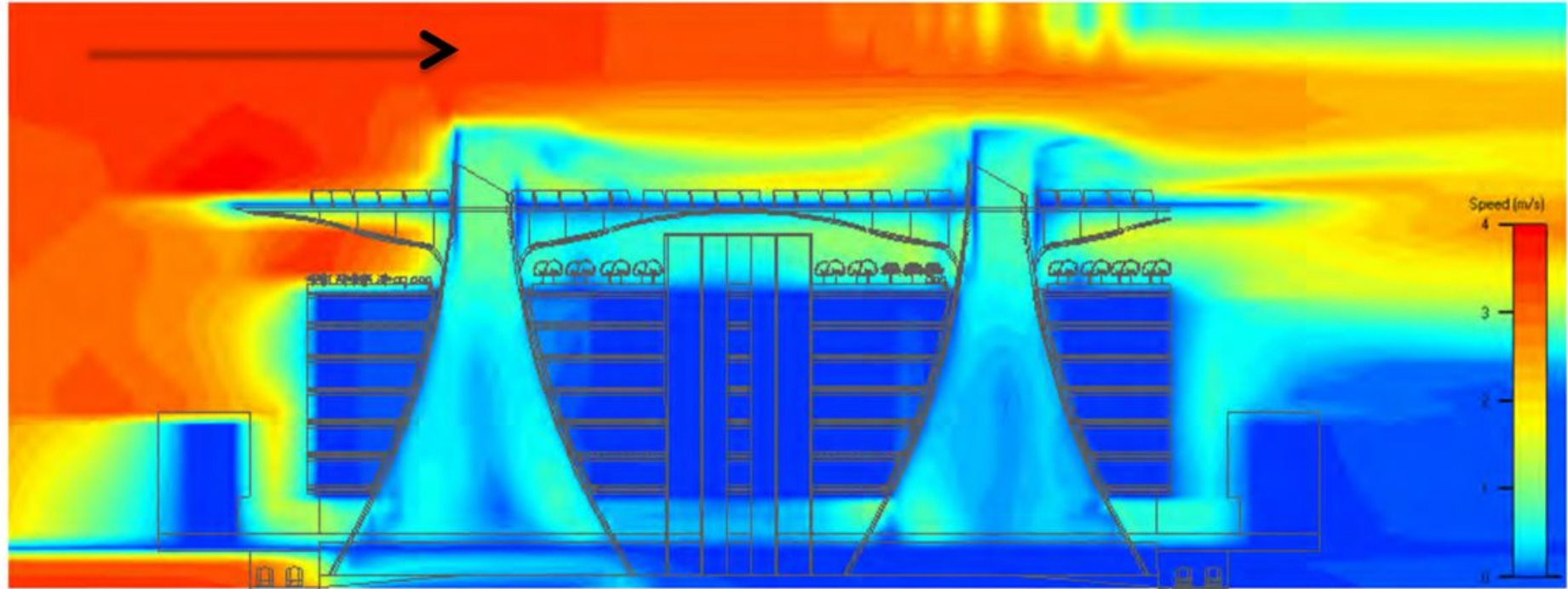


# MASDAR – A Net-Zero City (2008)



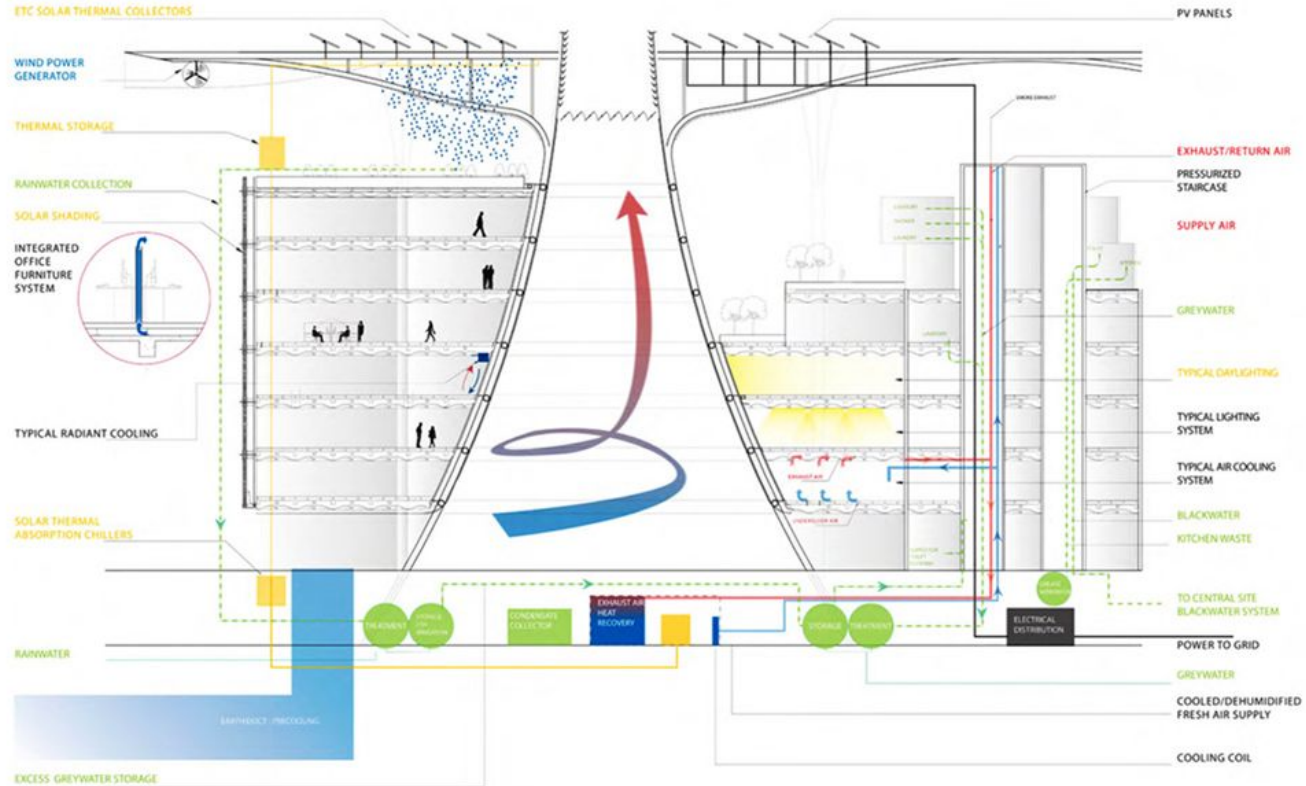
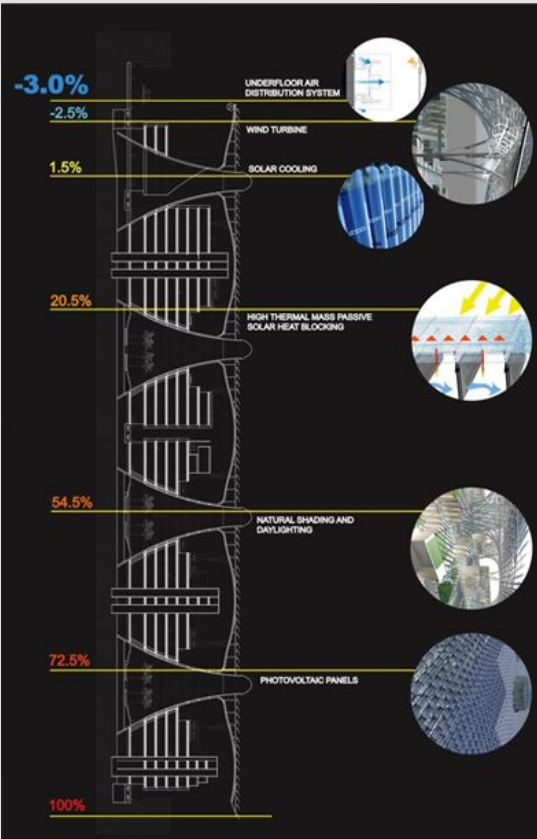
Question: How to allocate resources during a sandstorm?

# masdar-hq-ventilation-strategy



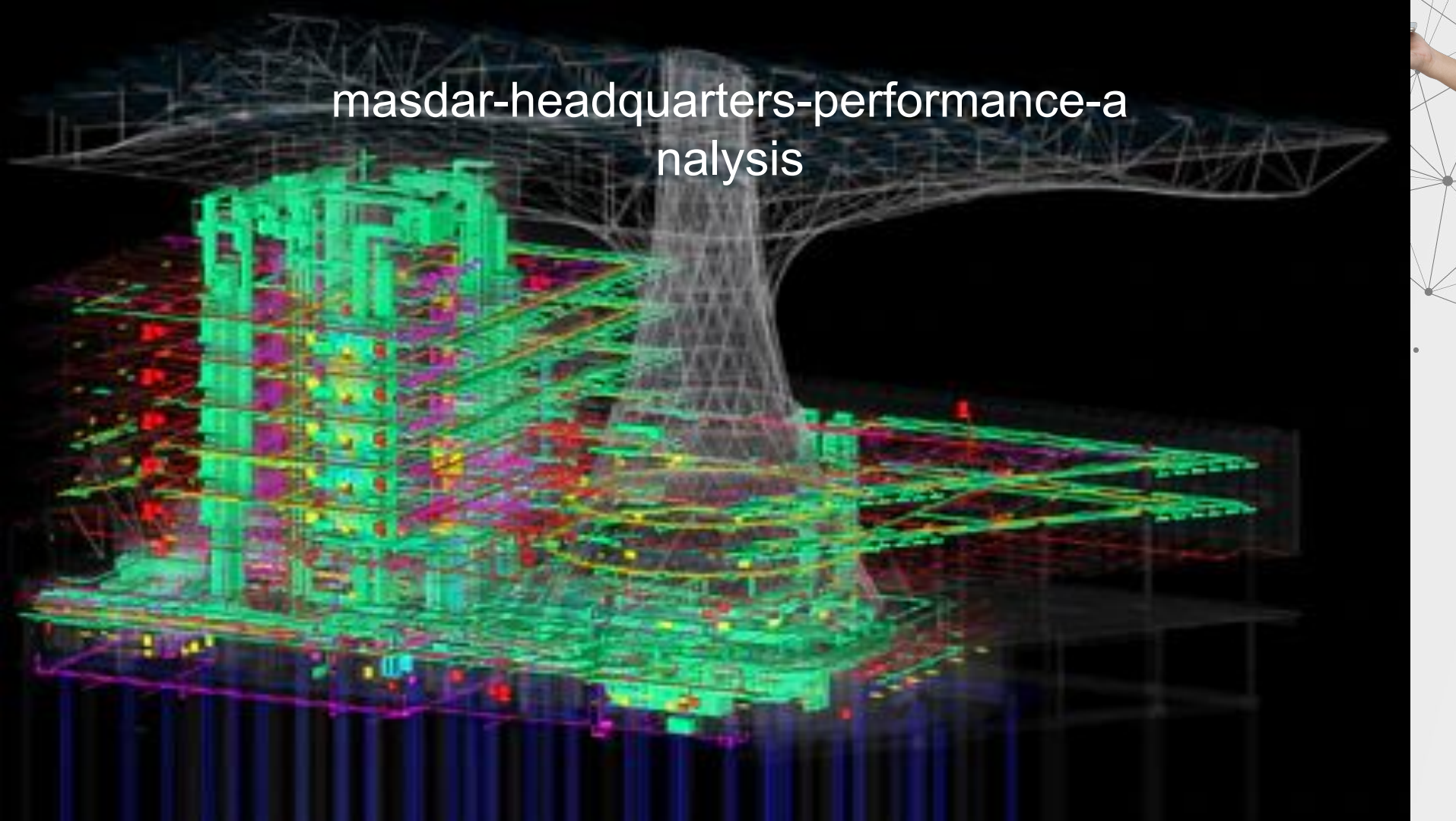
# masdar-hq-sustainability-strategies-d

## etail





# masdar-headquarters-performance-a nalysis





# MASDAR SYSTEMS

- **Building operation**

- Electrical generation and distribution
- Electrical energy meters
- Water meters
- Mechanical systems
- Public health systems
- Lighting control system
- Automated shading system
- Automated atrium roof lights
- Vertical transportation
- Public address system
- Digital signage system
- Sun tracking system
- Irrigation system
- Water features
- Information portal system
- Freight tracking RFID system

- Personnel RFID system
- MASDAR RFID tracking system
- Ventilation system for catering facilities
- Kitchen equipment
- Point of sale system
- Waste system
- Audio visual systems
- Library data base and alarm system
- Automated book storage facility
- **Transportation**
- PRT - Management centre
- PRT - Security system
- PRT - Ticketing system
- Vehicle management system
- LRT - Light Rail Transit System



# MASDAR SYSTEMS

- **Life Safety and Security**

- Seismic monitoring
- Structural anti-corrosion monitoring
- Fire detection/alarm system
- Fire Suppression systems
- Intruder detection system
- Closed circuit television system
- Access control system
- Emergency lighting system
- Oxygen depletion monitoring system
- Refrigerant leak detection system
- Water leak detection system
- Disabled refuge telephone system
- Fire fighters telephone system
- Smoke extract system
- Fire pump
- Sump pumps







<https://www.qmic.com/ar/>





# A SMART COUNTRY

Safe, Smart Cities



## Transport

- 'Blue Road' initiative will reduce 15-20 Degrees of the road
- Smart signals & cameras. Jams less by 10% in 2018



## Real Estate

### Lusail City

- A \$45 billion smart city infrastructure by 2020
- **Msheireb Downtown**  
A \$5.5 billion smart city infrastructure  
Occupying 310,000 sm



## Education

- Implementing eLearning  
Qatar maintains highest standards in education.



## Internet

- 5G lunched in May 2018
- First Internet penetration rate in worldwide (99% in 2017)
- The Internet of Things projected to reach \$573 million by 2022



## Healthcare

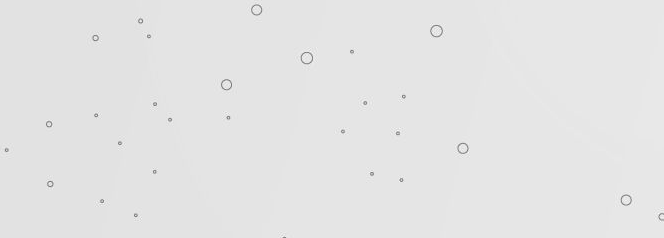
- 5<sup>th</sup> in the World in healthcare system in 2019
- \$9 Billion growth by 2020

INVESTING  
**\$4.4 B**  
INTO **ICT**  
SECTOR  
BY YEAR 2021



## Smart City Examples

- Songdo: <http://songdoibd.com/about/>
- Vienna: <https://smartcity.wien.gv.at/site/en/>
- Berlin: [http://www.berlinpartner.de/fileadmin/user\\_upload/01\\_chefredaktion/02\\_pdf/02\\_navi/21/Strategie\\_Smart\\_City\\_Berlin\\_en.pdf](http://www.berlinpartner.de/fileadmin/user_upload/01_chefredaktion/02_pdf/02_navi/21/Strategie_Smart_City_Berlin_en.pdf)
- Helsinki: <http://fiksukalasatama.fi/en/>



# Conclusion

## We actually don't need Smart Cities.....



We need to  
create.....  
Smart  
Citizens!







**REDUCE**  
**15-30**  
min/day  
**ON YOUR COMMUTE**

Intelligent traffic signals  
Smart parking

**REDUCE DISEASE**  
**BURDEN BY**  
**8-15%**

Telemedicine  
Real-time air-quality info

**REDUCE**  
**CRIME BY**  
**30-40%**

Real-time crime mapping  
Predictive policing

**REDUCE**  
**EMISSIONS BY**  
**10-15%**

Building automation  
Dynamic electricity  
pricing









# Smart City Standards

- The development of a standard on Smart city terminology (PAS 180)
- The development of a Smart city framework standard (PAS 181)
- The development of a Data concept model for smart cities (PAS 182)
- A Smart city overview document (PD 8100)
- A Smart city planning guidelines document (PD 8101)
- Mapping research and modelling for Smart Cities
- Guidance on the Economic Assessment and Funding of Smart City Initiatives



# Smart cities emerge as the result of many smart solutions across all sectors of society



Goals		Smart Mobility	Smart Safety	Smart Energy, Water & Waste	Smart Buildings & Living	Smart Health	Smart Education	Smart Finance	Smart Tourism & Leisure	Smart Retail & Logistics	Smart Manufacturing & Construction	Smart Government
 Economic growth												
 Quality of life, a good city to live in												
 Ecological footprint, sustainability ("planet")												
Challenges		Smart Mobility	Smart Safety	Smart Energy, Water & Waste	Smart Buildings & Living	Smart Health	Smart Education	Smart Finance	Smart Tourism & Leisure	Smart Retail & Logistics	Smart Manufacturing & Construction	Smart Government
 Controlled transition of the labor market due to automation												
 Winning the war on talent between metropolitan areas												
 Social cohesion, inclusiveness, solidarity												
 Secure digital environment, privacy												
 Resilience												







# Thank You for attending this presentation



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